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BIOLOGY.



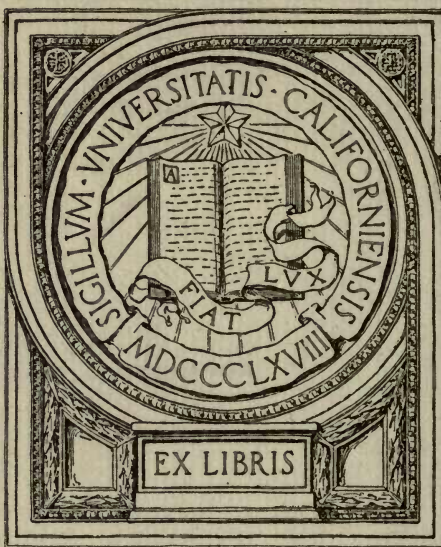
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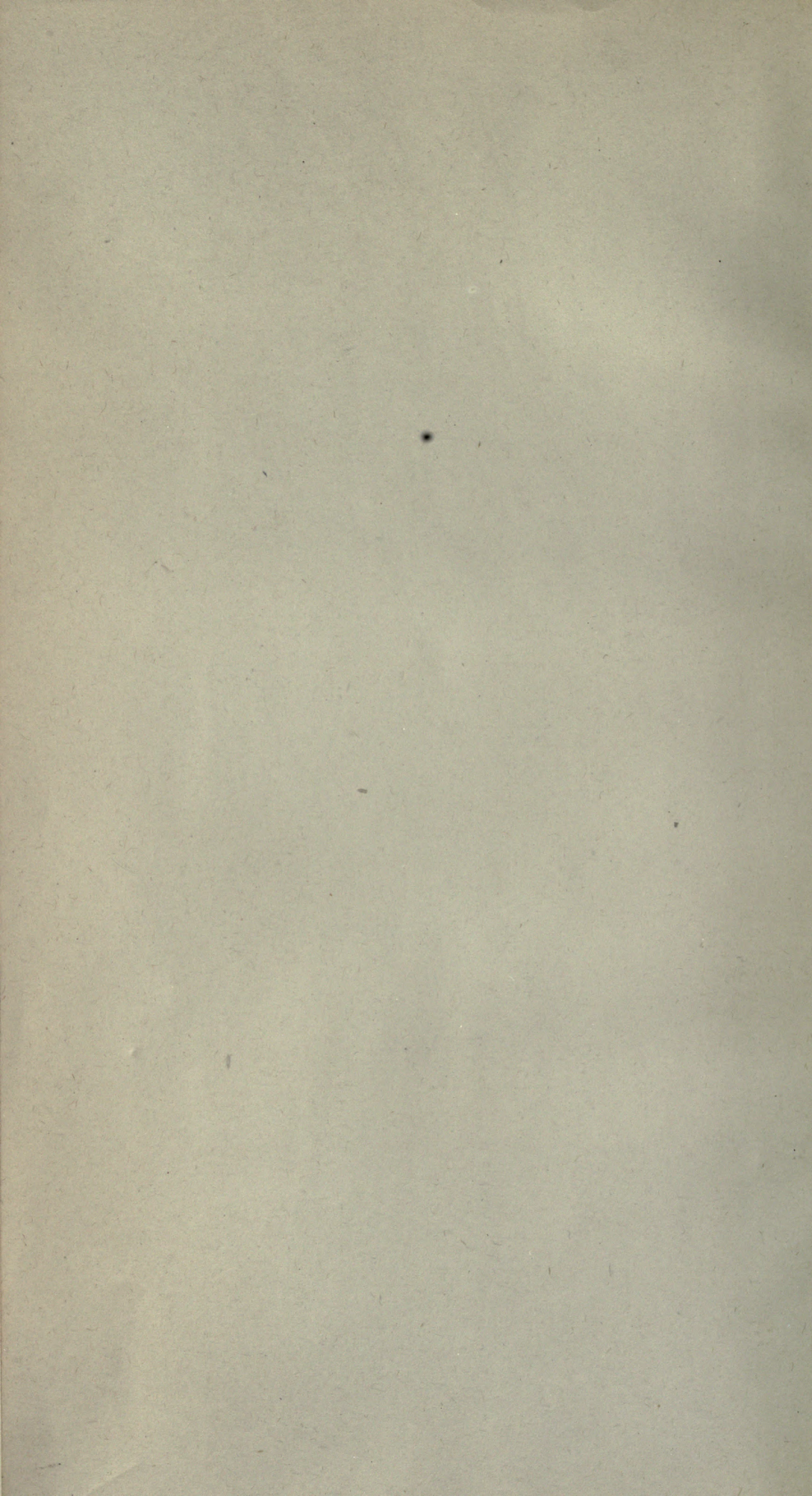
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1902

PRINTED FOR THE UNIVERSITY OF CALIFORNIA
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1902

Price 25 cents

PART VII.

BIOLOGY.

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* * Models, &c. similar to those described under Nos. 74, 132, 206, 213, 224, 231, 236, 237, 241, 295, 296, 299, 300, 319, 321-323 and 330 are circulated on loan for the use of Science Schools and Classes.

I. MICROSCOPES AND ACCESSORIES.

A. INSTRUMENTS OF HISTORIC INTEREST.

1. Copy made by Messrs. R. and J. Beck of the compound microscope said to have been invented and constructed about 1590 by Zacharias Janssen, spectacle-maker, Middleburgh, Netherlands. The original is the property of the Scientific Society of Zeeland.

E. 19.—1878.

2. Microscope, made by Benjamin Martin, Fleet St., about 1750; with five objectives, stage forceps, and ordinary forceps. Shagreen-covered case, with Lieberkühn's reflectors, six slides, and an old-fashioned form of live box.

E. 1.—1882

3. Culpepper microscope, made about 1790.

Lent by E. Russell Budden. 1876.

The stand consists of a circular brass base, from the circumference of which arise at equal intervals three scroll-shaped legs; these support the circular stage and above it the outer body-tube, in which slides the body of the microscope proper. There is no fine adjustment. The instrument is provided with a tall obelisk-shaped mahogany case.

4. Microscope with wooden and parchment body, and small circular stage.

Given by the Hon. W. F. R. Massey-Mainwaring.

E. 173.—1888.

5. Reflecting microscope, made by Prof. G. B. Amici, Director of the Observatory at Florence, for Dr. Wollaston, about 1830. Given by Lady Pollock, niece of Dr. Wollaston, to G. F. Pollock, Esq.

E. 6.—1881.

Given by G. F. Pollock.

The stand screws into the lid of the box which serves to contain the instrument. The tube is long, and placed horizontally, so that the observer looks forwards, not downwards. There is a hole in the lower side of the tube just above the stage, and over this a reflector at an angle of 45° . The coarse

adjustment is effected by moving the stage up and down by a rack and pinion.

6. Goring's "operative aplanic engscope."

E. 272.—1877.

Given by John Spiller.

This instrument is an early form of compound microscope mounted upon a ball and socket universal joint. A horizontal arm which bears the body of the microscope slides to and fro on the top of the vertical pillars. There is an oval plane mirror and a 2-inch condenser beneath the stage. In a separate box are opaque objects, stage forceps, and a stage condenser.

The instrument is described and figured in Pritchard's "Microscopic Illustrations," 1830.

7. Portable microscope, by Dollond, fixed to the bottom of a box, which thus serves as a base for the instrument. Tube shorter than in modern instruments of the English type; the whole is inclinable. The case contains materials for mounting objects, stage fixings, conical diaphragm, Lieberkühn's reflector, stage forceps, and a live box, consisting of two slips of brass hinged together and provided with holes covered with glass.

Lent by the late Bennett Woodcroft, F.R.S. 1876.

8. Old solar projection microscope, with a slide containing object glasses of six different powers, live cage, microscopic slides, forceps, and mounting materials. In box.

Lent by J. Waugh. 1876.

9. Japanese microscope, consisting of a tubular box $3\frac{3}{4}$ in. long by about 1 in. in diameter. The two ends of the box are fitted with two slightly concave lenses, which might do duty as a pair of spectacles. Within is a small double convex lens about $\frac{1}{4}$ in. diameter in a leaden frame, which can be placed in a hole on one side of the end of the tube, a pin to support the object being placed opposite to it.

E. 7.—1859.

Given by Capt. Creugh.

B. MODERN MICROSCOPES.

10. Microscope ["*Society of Arts*"], with horse-shoe stand; long, inclinable; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; plain brass stage; revolving diaphragm; plane and concave mirror; one eye-piece; $1\frac{1}{2}$ in., $\frac{1}{2}$ in., and $\frac{3}{8}$ in. objectives; condenser on separate stand; stage forceps; upright mahogany case with drawer.

Exhibited by R. Field & Co. 1859. Price 3l. 3s.

This microscope obtained a prize offered by the Society of Arts for the best microscope which could be supplied at the price quoted, hence its name. It is interesting as being the earliest cheap microscope of modern pattern.

11. Microscope ["*Student's*"], with tripod stand; long tube, inclinable; coarse adjustment by rack and pinion; no fine adjustment; round stage, revolving; revolving diaphragms; plane and concave mirror; one eye-piece; $1\frac{1}{2}$ in. and $\frac{1}{4}$ in. objectives; stage condenser; mahogany case, with drawer.

Exhibited by J. Parkes & Son. 1869. Price 2l.

12. Microscope ["*Student's*"], with bronzed tripod stand; long tube, inclinable; coarse adjustment by rack and pinion; no fine adjustment; stage with sliding bar to support objects; concave mirror; one eye-piece; $\frac{1}{4}$ in. objective.

Exhibited by Newton & Co. 1869. Price (complete) 3l. 3s.

13. Microscope on tripod stand; tube of medium length, inclinable; coarse adjustment by sliding tube; fine adjustment by micrometer screw; plain stage; revolving diaphragm; concave mirror; two eye-pieces; $\frac{2}{3}$ in. and $\frac{1}{6}$ in. objectives.

Exhibited by H. Crouch & Co. 1889. Price 5l. 5s.

14. Microscope ["*Star*"], with bronzed brass stand in form of two triangles; short tube, inclinable; coarse adjustment by sliding tube; fine adjustment by micrometer screw; plain stage with spring clips; iris diaphragm; plane and concave mirror; one eye-piece; 1 in. objective; cloth covered case.

Exhibited by R. & J. Beck. 1891. Price 2l. 2s.

15. Microscope [“*Student’s*”], with tripod stand ; long tube, inclinable ; coarse adjustment by rack and pinion ; fine adjustment by micrometer screw ; stage with a movable piece sliding up and down ; revolving diaphragms ; plane and concave mirror ; one eye-piece ; condenser on separate stand.

Exhibited by J. Parkes & Son. 1882. Price (complete)
3*l.* 10*s.*

16. Microscope [“*Student’s*”], with horse-shoe stand ; short tube, inclinable ; coarse adjustment by sliding tube ; fine adjustment by micrometer screw ; plain stage ; revolving diaphragm ; double mirror ; one eye-piece ; two objectives ; in mahogany case.

Exhibited by J. Swift & Son. 1880. Price 3*l.* 3*s.*

17. Microscope with horse-shoe stand ; long tube, not inclinable ; coarse adjustment by sliding tube ; fine adjustment by micrometer screw ; simple stage ; revolving diaphragms ; plane and concave mirror ; two eye-pieces ; $\frac{1}{8}$ th in. objective ; mahogany case in Hartnack pattern.

E. 237.—1877. *Made by Seibert & Krafft, Wetzlar.*

18. Microscope [“*Educational*”], with horse-shoe stand ; long body, inclinable ; coarse adjustment by rack and pinion ; fine adjustment by micrometer screw ; stage with two parallel magnetised steel bars fixed in it, upon which rests an iron cross-piece so that it will remain steady and retain the slide in any position in which it may be fixed ; revolving diaphragm ; plane and concave mirror ; one eye-piece ; no objectives shown ; stage condenser.

Exhibited by J. Parkes & Son. 1882.
Price (complete) 5*l.* 5*s.*

19. Microscope [“*Histological*”], with tripod stand ; short tube, inclinable ; coarse adjustment by rack and pinion ; fine adjustment by micrometer screw ; plain brass stage ; revolving diaphragm ; concave mirror ; one eye-piece ; 1 in. and $\frac{1}{4}$ in. objectives.

Exhibited by C. Collins. 1881. Price 5*l.* 10*s.*

20. Microscope [“*Museum*”], with horse-shoe stand ; short body, with draw tube, inclinable ; coarse adjustment by sliding tube ; fine adjustment by micrometer screw ; plain black stage ; revolving diaphragms ; small

concave mirror; two eye-pieces; 1 in. and $\frac{1}{4}$ in. objectives; horizontal mahogany case with recessed brass handle.

Exhibited by C. Baker. 1873. Price 5l. 10s.

21. Microscope ["College"], with tripod stand; short tube with draw-tube, inclinable; coarse adjustment by sliding tube; fine adjustment by micrometer screw; plain glass stage; revolving diaphragm; plane and concave mirror; eye-piece; two objectives; mahogany upright case with drawer.

Exhibited by Jas. Swift & Son. 1880. Price 5l. 5s.

22. Microscope ["Students"], with horse-shoe stand; long tube, inclinable; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; stage with sliding object-carrier; revolving diaphragm; single concave mirror; one eye-piece; one objective, which can be used for three powers (1 in., $\frac{1}{2}$ in., $\frac{1}{4}$ in.); condenser on separate stand; stage and hand forceps; live box; upright mahogany case with drawer.

Exhibited by T. Armstrong & Bro. 1885. Price 3l. 5s.

23. Microscope with horse-shoe stand; tube of medium length; inclinable body; coarse adjustment by sliding tube; fine adjustment by micrometer screw; objectives sliding into the tube; simple stage; cylinder diaphragms; two eye-pieces; two objectives; mahogany case of Hartnack's pattern.

Exhibited by P. Harris & Co. 1888. Price 6l. 10s.

24. Microscope ["English medical"], with bronzed horse-shoe stand; short inclinable tube; draw tube; coarse adjustment by sliding tube; fine adjustment by micrometer screw; plain black stage with spring clips; cylinder diaphragms; plane and concave mirror; one eye-piece; no objectives shown; sliding adapters for rapid changing; horizontal mahogany case with leather handle.

Exhibited by J. Parkes & Son. 1882. Price (complete) 6l.

25. Microscope ["Histological"], on bronzed horse-shoe stand, with short tube, inclinable; coarse adjustment by sliding tube; fine adjustment by micrometer screw; plain stage with steel clips; cylinder diaphragms;

plane and concave mirror; two eye-pieces; $1\frac{1}{2}$ in., $\frac{2}{3}$ in., and $\frac{1}{6}$ in. objectives; condenser on separate stand; horizontal mahogany case with leather handle.

Exhibited by T. Armstrong & Bro. 1885. Price 6l.

26. Microscope on tripod stand, with short tube, inclinable; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; glass stage, revolving diaphragms; double mirror. In upright mahogany case with drawer for slides.

Exhibited by Reynolds and Branson. 1888. Price 4l. 4s.

27. Microscope on tripod stand, with long tube, inclinable body; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; stage with loose sliding piece to support objects; revolving diaphragms; single concave mirror; two eye-pieces; 1 in. objective; condenser on separate stand.

Exhibited by Newton & Co. Price (complete) 5l. 5s.

28. Microscope with horse-shoe stand, long tube, inclinable; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; mechanical stage; revolving diaphragm; concave mirror; one eye-piece; two objectives; condenser on separate stand; brass forceps and live box; upright mahogany case with drawer for slides.

Exhibited by Townson and Mercer. 1886. Price 8l. 15s.

29. Microscope on bronzed tripod stand, with long tube, inclinable; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; mechanical stage; revolving diaphragm; concave mirror; two eye-pieces; 1 in. objective; condenser on separate stand; live box.

Exhibited by Newton & Co. 1869. Price (complete) 7l. 7s.

30. Microscope with double pillar stand, long tube, inclinable; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; mechanical stage, with horizontal motion in all directions and also rotating; revolving diaphragm, which, however, has no catch to indicate when it is centred; plane and concave mirror; two eye-pieces; 1 in., $\frac{1}{2}$ in., and $\frac{1}{4}$ in. objectives; condenser on separate stand and polarizing apparatus. Used by Messrs. Kerr and Wallich. Made by J. White, Glasgow.

Lent by the Government Grant Committee of the Royal Society. 1888.

31. Microscope, with tripod stand; long body, inclinable, and having a movement of rotation around its support; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; mechanical stage having rectangular movements; revolving diaphragm; plane and concave mirror; three eye-pieces; seven objectives (from 3 in. to $\frac{1}{12}$ in.) by different makers; double nose-piece; stage and stand condensers; Lieberkuhn's reflectors (4) and parabolic side illuminator; Wollaston's camera lucida and a total reflection prism: also stage and hand forceps and live boxes. Supplied with polarizing apparatus and the requisite sub-stage adjustments. In two mahogany cases. Made by Jas. Smith.

E. 28.—1891. *Bequeathed by Miss S. Marshall.*

32. Microscope, with horse-shoe stand; long, inclinable body; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; mechanical stage with rectangular movements; revolving diaphragm; plane and concave mirror; four eye-pieces; 2 in., $\frac{1}{2}$ in., $\frac{1}{4}$ in., $\frac{1}{8}$ in., $\frac{1}{12}$ in. objectives; stage forceps. Supplied with screw micrometer, Noberts' test and micrometer, Maltwood's finder, and various micrometric scales. Adapted for use as a polarizing microscope. In upright mahogany case. Made by A. Ross.

E. 29.—1891. *Bequeathed by Miss S. Marshall.*

33. Microscope on double pillar stand, with long tube, inclinable; coarse adjustment by rack and pinion; fine adjustment by micrometer screw; mechanical stage; revolving diaphragms; double mirror; two eye-pieces; no objectives shown; condenser on separate stand; stage forceps and live box.

Exhibited by Newton & Co. 1869. Price (complete) 10l.

34. Microscope with large horse-shoe stand; short tube with graduated draw tube, inclinable; coarse adjustment by rack and pinion; fine adjustment by graduated micrometer screw; plain black stage with nickel clips; stage and all above it rotating about the optical axis; cylinder diaphragms with apparatus for centering, mounted on a swinging arm with rack and pinion elevator; plane and convex mirror; two eye-pieces (Nos. 1 and 2); two objectives (A and D); upright mahogany case with places for accessories.

Abbé's substage condenser; one or more lenses ground into the form of a truncated cone above, fit just below the stage; the diaphragms (of six different sizes) are situated below the lenses and can be moved from the centre by a rack and pinion and also rotated round the optical axis.

Apochromatic objectives of 16 mm. ($\frac{2}{3}$ in.), 8 mm. ($\frac{1}{3}$ in.), and 4 mm. ($\frac{1}{6}$ in.) dry, and 3 mm. ($\frac{1}{8}$ in.) homogeneous immersion, made of special glass and having the necessary corrections carried out on a new principle devised by Professor Abbé.

Compensation eye-pieces, Nos. 4, 8, 12, and 18 so arranged that they multiply the image formed by the objective by an amount corresponding with these numbers, and also that as each one is successively placed in the tube the object remains in focus.

E. 192 and 193.—1888.

Made by C. Zeiss, Jena.

C. SIMPLE MICROSCOPES.

35. Dissecting microscope; upright pillar with very small stage; rack and pinion adjustment; two lenses which swing into and out of position; plane mirror; condenser fixed to the stage; mahogany case with live box and forceps.

Exhibited by P. Harris & Co. 1888.

Price 10s. 6d.

36. Coddington lens in nickel mount.

Exhibited by Pastorelli & Co. 1860. Price 5s.

37. Simple arrangement for examining microscopic objects contained in water or other liquids. Probably part of a set of apparatus used for the instruction of the royal residents at Kew.

E. 20.—1891. *Given by W. T. Thiselton Dyer, F.R.S.*

D. OPTICAL ACCESSORIES.

38. Substage condenser with $\frac{1}{6}$ inch achromatic objective made by direction of Dr. Wallich.

Lent by Govt. Grant Committee of the Royal Society. 1889.

39. Camera lucida for drawing with the microscope, designed by Dr. Abbé.

E. 16.—1889.

Made by C. Zeiss, Jena.

The rays from the paper and pencil are reflected first from the large mirror in a horizontal direction, after which a small mirror above the eye-piece directs them into the eye along with the rays which have passed through the microscope. The appearance presented is that the pencil has been transferred to a point just below the observer's eye.

40. Slit and prisms used in the first form of spectrum microscope.

Lent by Dr. H. C. Sorby, F.R.S. 1876.

The slit is made of two flat strips of brass with even edges, which can be approximated to each other and fixed parallel by means of screws. This part of the apparatus is fixed into a shutter erected in front of the microscope so as to exclude extraneous light.

To the substage tube of the microscope carrying an achromatic condenser is fixed at its lower end a cap, in which is inserted a crown glass prism of suitable angle, so that the rays, which come almost horizontally from the slit, are thrown up along the optical axis of the instrument. Substances whose absorptive power it is desired to test can be placed either in front of the slit or on the stage of the microscope. This form of apparatus is now quite superseded by No. 41.

This apparatus is described in the exhibitor's paper in the "Quarterly Journal of Science," 1865, vol. ii., p. 198.

41. Micro-spectroscope, designed by Dr. H. C. Sorby.

E. 188.—1888.

Made by J. Browning.

The instrument fits into the microscope in place of the eye-piece. In addition to the light coming through the microscope, rays can also enter through the side of the tube and the two spectra are viewed side by side for convenience in comparing them. Both slits are provided with screws for opening and closing them. The eye-piece has a rack and pinion for focussing. The small cross tube at the top throws the image of a lozenge-shaped spot of light into the field of view along with the spectra, and it can be moved along by a micrometer screw so as to mark accurately the position of any line in the spectrum.

E. SLIDES.

42. Holman's "current" slide.

Lent by D. S. Holman, Philadelphia. 1876.

This is a glass slide with two shallow circular depressions, each of which has a deeper oval excavation at its outer side. They are connected by a groove.

43. Holman's "siphon" slide.*Lent by D. S. Holman, Philadelphia. 1876.*

This is a thick glass slide with a longitudinal trough, shallow at the sides, deeper in the middle. At either end is a smaller trough, into which opens a small brass tube. The central trough is connected with the lateral ones by seven shallow grooves, and there is a talc cover for them all.

44. Holman's "life" slide.*Lent by D. S. Holman, Philadelphia. 1876.*

This is a thick glass slide with a deep depression in the middle, a shallow groove crosses this at either end.

F. LAMPS.

45. Microscope lamp, with flat wick to burn paraffin oil; porcelain shade with notch to allow light to shine on mirror of microscope, mounted on brass ring-stand with upright rod on which it slides.

Exhibited by F. Darton & Co. 1875. Price 15s.

46. Microscope lamp with flat wick to burn paraffin oil; white chimney and porcelain shade with notch on brass circular stand with bronzed rod.

*E. 49.—1889.**Bought from F. Pastorelli.*

47. Microscope lamp with flat wick to burn paraffin oil; blue chimney and porcelain shade with notch as above. Mounted on an iron stand with upright brass rod on which it slides.

*E. 50.—1889.**Bought from F. Pastorelli.*

48. Microscope lamp for conveying the light by total reflection immediately below the object on the stage. By Koch and Wolf.

*E. 9.—1889.**Made by F. Kalthoff, Bonn.*

The metal chimney is perforated and into the apertures corks are inserted through which pass glass rods directed towards the flame. The light passes along the interior of the rod and is reflected along its curves and upwards directly into the object glass of the microscope. There are two rods of different curvatures, one of which can be used for opaque objects.

49. Reading lamp on brass stand with evaporator.*Exhibited by J. Parkes & Son. 1882. Price 16s. 6d.*

This is a small paraffin lamp with a flat wick, mounted on a ring stand with upright rod on which it slides. The glass chimney is surrounded by a metal lantern with a circular glass front; the upper part forms a shallow tray, with a perforated cover, which can be filled with water.

G. MICROSCOPIC PREPARATIONS.

50. Cabinets (3) containing zoological, botanical, and other microscopic preparations, including diatomaceæ, gorgonidæ, and foraminifera. Also a collection of microphotographs, illustrations of microscopic ruling, and slides specially prepared for observations with polarized light.

E. 30.—1891.

Bequeathed by Miss S. Marshall.

51. Microscopic preparations in cabinets for the use of students.

E. 397–399.—1877.

*Presented by A. C. Cole & Son.***A. Educational Series.**

1. Adipose tissue.
2. Connective tissue.
3. Yellow elastic tissue.
4. Striped muscular fibre.
5. Unstriped "
6. Tendon, longitudinal section.
7. " transverse section.
8. Yellow elastic cartilage.
9. Hyaline costal cartilage.
10. Bone, longitudinal section.
11. " transverse section.
12. Parietal bone, transverse section.
13. Section of scalp, showing hair follicles.
14. Nerve fibres.
15. Spinal cord, transverse section, showing nerve cells.
16. Skin, vertical section.
17. Tooth, longitudinal section.
18. Capillary vessels in the pia-mater.
19. Skin of frog, showing pigment cells.
20. Lung of cat, section, injected.
21. Liver " "
22. Brain " "
23. Kidney of rabbit, section, injected.
24. Intestine, transverse section.

B. Physiological Series.

1. Tongue, transverse section. Man.
2. Ileum, surface view of mucous membrane. Man.
3. Kidney, artery injected. Man.
4. " artery and vein injected. Man.
5. Skin, vertical section. Man.
6. Cerebellum. Man.
7. Cerebrum. Man.
8. Stomach. Man.
9. Pancreas. Man.
10. Placenta. Man.
11. Cuticle, with hair follicles. Man.
12. Thyroid body. Man.
13. Ileum, transverse section. Cat.
14. Lung. Cat.
15. Cerebrum. Cat.
16. Tongue, transverse section. Cat.
17. Liver, doubly injected. Cat.
18. Bladder, transverse section. Cat.
19. Stomach. Dog.
20. Salivary gland (parotid). Pig.
21. Large intestine, surface view of mucous membrane.
Rabbit.
22. Ileum, surface view of mucous membrane. Rabbit.
23. Kidney, artery and vein injected. Cat.
24. Tongue, transverse section. Rabbit.

C. Pathological Series.

1. Lung. Phthisis.
2. " Catarrhal pneumonia.
3. " Croupous "
4. Liver. Amyloid.
5. " Cancer.
6. " Cirrhosis.
7. " Fatty degeneration.
8. " Indurated.
9. " Syphilis.
10. Kidney. Scarlatinal nephritis.
11. " Bright's disease.
12. " Fatty degeneration.
13. " Cirrhosis
14. " Syphilis.
15. Spleen. Amyloid.
16. Stomach. Cancer.
17. Lymphatic gland. Hypertrophy.
18. Mamma. Scirrhus tumour.
19. Uterus. Fibroid tumour.
20. Lip. Epithelioma.

- 21. Aorta. Atheroma.
- 22. Intestine. Typhoid ulceration.
- 23. Neck. Malignant tumour.
- 24. Perinæum. Vascular tumour.

52. Microscopic objects, including diatomaceæ, foraminifera, radiolaria, &c. Grouped and selected. On plain and opal glass. In a frame.
Exhibited by A. C. Cole. Prices from 1s. 6d. to 4s. 6d. each.
 1868.

53. Collection of 13 various microscopic objects for elementary instruction in the use of the instrument.
Exhibited by F. Pastorelli & Co. 1860.

54. Collection of microscopic preparations chiefly of the nervous system of various species of Mollusca.
Presented by Dr. Ph. Orsiannikov, University of St. E. 490.—1877. Petersburg.

- 1. Central nervous system of *Thetis* mounted whole.
- 2, 3. Sections of the same.
- 4. Central nervous system of *Æolis*.
- 5, 6. " " *Gastropteron*.
- 7. " " *Bulla*, showing the pigmented eyes.
- 8. " " *Umbrella*.
- 9. " " *Pleurobranchus*.
- 10. Section of a nerve-ganglion of *Aplustrum*.
- 11. Central nervous system of *Aplysia*.
- 12. Section of the electric organ of a Ray. Made from a specimen preserved for three years in spirit, the cells and fibres are still seen very well.
- 13. Central nervous system of *Dentalium*.

55. Microscopic preparations of typical botanical objects arranged in series to illustrate :—
a. Physiological anatomy of plants.
b. Comparative anatomy of plants.
c. Classification or special morphology of plants.
d. Life history of plants.
E. 24.—1891. Prepared by Martin J. Cole.

H. REAGENTS FOR MICROSCOPIC WORK.

56. Set of the more commonly used reagents :—
 Iodine green, 1s.
 Borax carmine, 10d.

Picro-lithium carmine, 1s.
 Bismarck brown, in glycerine, 10d.
 Hæmatoxylin (Ehrlich's), 1s. 4d.
 Iodine stain, 1s. 6d.
 Fuchsin (magenta), 1s. 6d.
 Methylene blue, 1s.
 Indigo carmine, 1s.
 Violet gentian, 1s. 6d.
 Lithium carmine, 1s.
 Eosine (blue shade), 1s.
 Double stain (Dr. Gibbes), 1s. 2d.
 Spiller's purple, 1s. 6d.
 Canada balsam dissolved in benzole, 1s. 6d.
 Oil of cloves, 2s. 4d.
 Cedar oil, 2s. 6d.

Exhibited by F. E. Becker & Co. 1886.

I. MICROTOMES.

57. Microtome for cutting thin sections of wood, as well as other substances, devised by Andrew Pritchard, F.R.S.E., prior to 1835.

Lent by Dr. Urban Pritchard. 1876.

The apparatus is made to be screwed to the edge of a table, and consists of a flat plate of brass with a well in it, in which a kind of piston moves up and down by a micrometer screw. The wood to be cut is fixed to the piston by a small screw, and as it is raised a knife drawn along the plane surface takes off thin sections. Should the piece of wood be too small to be placed in the triangular chamber, it must be glued to a block of convenient size.

58. Microtome for freezing small pieces of soft tissues with a view to section cutting.

Lent by Dr. Urban Pritchard. 1876.

The apparatus consists of a solid copper cylinder with a wooden handle. The cylinder is immersed in a freezing mixture until it has assumed a temperature considerably below freezing. It is then removed and wiped dry, and the tissue, soaked in gum, is placed upon its flat end and covered with a thick cap of felt. In a short time it will be frozen hard, and the sections can be cut free hand by an ordinary razor.

59. Microtome devised by Professor Rutherford for cutting frozen tissues. *Exhibited by J. Gardner.* 1876.

As in No. 57, there is a piston which can be raised in a well by means of a micrometer screw. The tissue, soaked in gum, is placed in the well, and a freezing mixture placed in a trough around this. The razor slides upon a plane surface of brass, and there is a screw clamp by which the apparatus can be attached to a table. For description, see Rutherford, "Outlines of Practical Histology," London, 1875.

60. Microtome designed by Professor C. S. Roy for cutting objects frozen by the ether spray.

Made by the Cambridge Scientific Instrument Co.

E. 30.—1887.

The object, preferably soaked in gum, is placed on a thin metal plate, upon the under surface of which the spray is directed. The razor is carried by an arm which rotates about a vertical axis, and is made to descend a little between every cut by means of a ratchet. An additional clamp is supplied for holding objects which have been embedded.

61. Microtome for cutting objects embedded in paraffin into ribbons, known as the "Rocking Microtome."

Made by the Cambridge Scientific Instrument Co.

E. 144.—1888.

The razor is held horizontally with its edge upwards by two clamps, and the object is fixed to the end of a lever which moves up and down close to it. The axis of the lever rests upon the upright arm of another lever, which has a horizontal arm actuated by a micrometer screw, so that as it is raised the object is thrown forward against the razor. The lever which carries the object is moved up and down by a handle placed on the same axis as the micrometer screw, and actuating it by means of a pawl and ratchet; a movable piece, which lifts the pawl from the ratchet for any desired interval, provides the means of varying the thickness of the section.

62. Microtome, similar to No. 61.

Exhibited by the Cambridge Scientific Instrument Co. 1885.

63. Microtome for cutting embedded sections, consisting of a circular plate of glass supported by two pillars upon a heavy stand. In the centre is a well with a piston moved up and down by a micrometer

screw. The pitch of the screw is 1 mm., and the head is divided into 100 parts, so that a rise of 0.01 mm. can be read. Two tubes for holding objects fitting into the well are provided. The sections are cut by an ordinary razor sliding upon the glass plate.

E. 29.—1887.

Made by C. Zeiss, Jena.

64. Microtome of the same general structure as No. 63, with razor.

1876.

65. Microtome, similar in principle and construction to Nos. 63 and 64, for cutting embedded materials. Price 15s.

Exhibited by Rigg's Technical Education Appliances Co.
1889.

66. Microtome, consisting of two elongated iron troughs side by side; one is horizontal, the other has a slope of 1 in 20. In the former slides a block which carries the razor, whilst in the latter is a block provided with a clamp to carry the object to be cut. This can be moved up the incline by a micrometer screw, which can be clamped at any point on the slope. The razor is moved to and fro along one slide, and between every forward stroke the object is moved a little up the other. As the incline is 1 in 20, the pitch of the screw 0.3 mm., and the head of the screw is graduated into 15 parts, a rise of 0.001 mm. can be brought about.

With the instrument is an object holder of Koch's pattern.

E. 31.—1887.

Made by R. Jung, Heidelberg.

67. Microtome on the same principle as No. 66, but with the following modifications:—

The razor clamp is made to hold the knife at any point, and the carrier has an arrangement to prevent it from rising in the groove. The divided drum on the micrometer screw has an arrangement whereby a catch falls into a notch either once or several times in each revolution as desired. The object holder has movements of rotation in two directions, so as to facilitate the cutting of the object in any given plane. There is an apparatus for freezing tissues to be cut by the ether spray, which can be fixed upon the object carrier. There is also a holder for cutting botanical and other objects when fixed in pith.

Made by R. Jung, Heidelberg.

E. 24.—1889.

68. Minot's Automatic Microtome.

E. 53.—1889.

Made by E. Zimmermann.

The knife is stationary. The object carrier is attached to a sliding base; this and the driving wheel which actuates it are both massive, and so constructed that the object is caused to move in a vertical plane, with the maximum downward pressure. The forward displacement of the object carrier is effected at every revolution of the driving wheel by means of a micrometer screw. The wheel which turns the screw is actuated by a pawl and upright lever apparatus, under control of a set-screw which bears a series of arms of graduating lengths. The working parts may be so adjusted that a cutting capacity of from 0.04 mms. to 0.0033 mm. may be assured at will. The instrument is provided with a ribbon receiver for paraffin sections, and with six object carriers.

69. Ryder's Automatic Microtome.

E. 41.—1889.

Made by J. Zentmayer.

The object carrier is borne upon an oscillating lever, under control of a spring, and so constructed that at every complete oscillation the imbedded object is pulled down upon the razor, previously fixed in position. The knife holder is so arranged that the razor-edge may be set at any angle to the direction of the paraffin block. The movements of the lever are adjusted by a screw fixed to a toothed wheel of 3 in. diameter, and these are actuated by a pawl fixed to the side of the lever. The number of teeth which this pawl can pass in a single oscillation is determined by a stop attached to the under side of the lever, which, on being caused to strike the bed-plate, brings the lever to rest at a constant point for each movement in a downward direction.

An adjustable sector is placed beside the toothed wheel, for the purpose of throwing the pawl out of gear, and this is so arranged that the necessary adjustments are effected at each oscillation, before the imbedding material, with its contained object, reaches the knife.

Sections cut through the arc embraced by a single tooth of the revolving wheel would have a thickness of 0.0025 mm. ($\frac{1}{100,000}$ of an inch).

J. DRAWINGS OF MICROSCOPIC OBJECTS.**70. Camera lucida drawings of microscopic objects.***Exhibited by R. and J. Beck. 1876.*

Leaf insect from sycamore.

Acarus from fly.

Flea from cat.

Tarsus of corn weevil.

Retina of rabbit (carmine injection).
 Ova of toad (vermilion and size injection).
 Eyeball of rat (carmine injection).
 Glandular stomach of owl (carmine injection).

71. Enlarged drawings of microscopic objects, by T. Higgin.

Acarus from the head of a humble bee.
 Proboscis of the blowfly.
 Yellow grass fly.
 Diatomaceæ, group from shell débris in Bombay harbour.
 Eupodiscus Hardmanianus from shell cleanings in the South Pacific Ocean.

Given by T. Higgin. 1870.

72. Enlarged photographs (6) of microscopic objects, by J. R. Traer.

Lent by J. R. Traer. 1857.

Proboscis of blowfly.

Acarus.

Foot of spider.

73. Enlarged figures of pelagic animals, drawn by Francis Ingram Palmer during voyages of H.M.Ss. "Rodney" and "Sylvia" between December 1866 and April 1870.

With a chart giving the tracks taken by these vessels.
 In gilt frame 8 ft. by 12 ft.

Lent by Lieutenant F. I. Palmer, R.N. 1872.

K. DISSECTING INSTRUMENTS.

74. Case of dissecting instruments.

E. 156.—1874.

Made by C. Baker.

Three scalpels.

Two pairs of forceps.

Probe.

Blowpipe.

Aneurism needle.

Two pairs of scissors.

75. Set of dissecting instruments for the use of students. In mahogany case.

Four scalpels.

Coarse scissors.

Fine scissors.

Coarse forceps.

Fine forceps.

Two razors.

Bone forceps.

Seeker.

Blowpipe.

Exhibited by J. Swift and Son. 1880. Price 26s.

76. Case of dissecting instruments.*Exhibited by Reynolds and Branson. 1888. Price 10s.*

Five scalpels.

Blowpipe.

Scissors.

Chain and hooks.

Aneurism needle.

Forceps.

II. ZOOLOGY.**A. PHYSIOLOGICAL APPARATUS.****i. Apparatus used in various Experiments.****77. Recording drum with clockwork motion.** Made by the Cambridge Scientific Instrument Co.*Lent by the Physical Laboratory, Royal College of Science. 1888.***78. Apparatus for measuring and recording small intervals of time by means of the tuning-fork.***Lent by the Biological Laboratory, Royal College of Science. 1878.*

A tuning-fork has a small point attached to one of its arms so that its vibrations may be written on a revolving drum. The fork is placed opposite the poles of a powerful electro-magnet, and is so arranged that as it vibrates the current is alternately broken and allowed to pass. In this way the movement of the fork can be maintained for any desired period. There are two magnets, large and small, and a set of tuning forks.

79. Electrical apparatus used in physiological experiments.*Lent by the Biological Laboratory, Royal College of Science. 1878.***1. Galvanic batteries :—**

Four cells of Daniell's battery.

Two bichromate batteries.

Two Grove's batteries, each with four cells.

2. Two of Du Bois Reymond's induction coils, in which the secondary coil can be moved to a considerable distance from the primary, so as to diminish its strength to any required degree.**3. Rheocord for measuring the amount of resistance to the current.****4. Four Du Bois Reymond's keys for making or breaking the circuit.****5. Shunt for use with the galvanometer to diminish the deflection of the needle.**

80. Magneto-electric machine, by Ladd.

Lent by the Biological Laboratory, Royal College of Science. 1878.

This is an old pattern, formerly used for medical purposes. The horse-shoe magnet is in the form of an almost complete circle and the coils revolve between its poles.

81. Spectroscope, by Browning.

Lent by the Biological Laboratory, Royal College of Science. 1878.

The instrument has two prisms mounted on an 8-inch graduated circle.

82. Thermometers by various makers and graduated in different ways to serve a variety of purposes.

I. Made by Geissler and Son, Berlin.

Thermometer graduated on Prof. Virchow's plan. The range is from 0° to 50° C.; each degree divided into tenths. E. 242.—1877.

Thermometer graduated on Prof. Haidenhain's plan. The range is from 28° to 46° C. E. 243.—1877.

Thermometer with a broad flat bulb for determining the temperature of the skin. Graduated to tenths of a degree. E. 244.—1877.

Thermometer for determining the temperature of the ear. E. 245.—1877.

II. Made by W. Haak, Neuhaus, Thüringen.

Two thermometers graduated on Prof. Virchow's plan. E. 96, 97.—1877.

Two thermometers devised by Dr. Traube for medical use. The range is from 23° C. in one case, 26° C. in the other, to 46° C., and each degree is divided into tenths. E. 106, 107.—1877.

III. Designed and presented by M. Immisch.

A small thermometer in circular metal case. The changes in temperature affect the form of a small closed curved tube, which moves a needle round an index. The instrument is intended for ascertaining the temperature of the human body. E. 117.—1886.

A similar instrument from which the face has been removed to show the internal structure. E. 118.—1886.

83. Two thermometers graduated in degrees C, from —10 to 310 and 380 degrees respectively.

Lent by the Biological Laboratory, Royal College of Science. 1878.

84. Measuring tube graduated in fifths to 50 cc.

Lent by the Biological Laboratory, Royal College of Science. 1878.

85. Three burettes, with stopcocks graduated in tenths to 60 cc.

Lent by the Biological Laboratory, Royal College of Science. 1878.

86. Two hydrometers, graduated on ivory.

Lent by the Biological Laboratory, Royal College of Science. 1878.

87. Apparatus for artificial respiration.

Lent by the Government Grant Committee of the Royal Society, 1891.

88. Water-motor for driving small machinery.

Made by the Cambridge Scientific Instrument Company.
E. 145.—1888.

ii. *Apparatus used in Experiments on Muscle and Nerve.*

89. Old form of moist chamber for muscle and nerve experiments.

Lent by the Biological Laboratory, Royal College of Science. 1878.

In this apparatus a small tray can be raised or lowered upon a vertical rod. There is a clamp to hold the bone to which the muscle is attached, and a bar upon which the electrodes slide, with binding screws for the wires conveying the current. The muscle and nerve are covered by a bell glass.

90. Moist chamber of improved pattern.

Made by the Cambridge Scientific Instrument Company.
E. 177.—1888.

There is a simple arrangement for placing the electrodes in position without the use of adjusting screws. The supports are perfectly inelastic and hence when placed in position do not spring away from it. The glass case is oblong in form, and may be charged with moist air immediately on placing the preparation in position.

91. Apparatus used by Dr. Warner in his investigations on the movements of the limbs.

The apparatus consists of :—

Dudgeon's sphygmograph.

Set of tambours in case, with electrical connections.

Electrical apparatus for enumerating combinations and series of movements in the various parts of the human body.

Recording drums to be driven by clockwork, with wells and syphon tubes for recording. In mahogany case. The apparatus is referred to in Warner's "Physical Expression, its Modes and Principles."

Lent by the Government Grant Committee of the Royal Society. 1888 & 1890.

iii. *Apparatus for Experiments on the Circulatory Organs.*

92. Pair of levers for experiments on the frog's heart.

Lent by Dr. T. Lauder Brunton, F.R.S. 1876.

This very simple apparatus for demonstrating the phenomena of the frog's heart-beat, even to considerable numbers of people, consists of a small base plate of tin or glass, four inches long by three wide. At one side of the end an ordinary cork cut square is fastened so that half of it projects over the end. A pin stuck horizontally into this serves as a pivot for a little slip of wood three inches long, a quarter of an inch broad, and one-eighth of an inch thick. To one end of this piece of wood a long straw is fastened by sealing wax, and a disc of paper is similarly attached to the other end of the straw so as to render its movements conspicuous. The frog's heart rests upon the plate under the piece of wood and thus makes the straw rise and fall with its contractions. To counterbalance the wood and straw and prevent them from pressing unduly upon the heart a small clamp is attached to the free end of the wood. By placing the plate alternately over a lamp and over pounded ice the effects of heat and cold, and by applying solutions of various drugs to the heart, the effects of poisons can be shown.

93. Apparatus for studying the contraction of the frog's heart. Constructed by E. S. Stöhrer.

From the Physiological Institute, Leipzig.

E. 248.—1877.

The apparatus consists essentially of two cannulæ, one inserted into the vena cava, the other into the aorta of the heart under investigation. This is then fed with a mixture of serum and salt solution, and the pressure exerted by each contraction measured by a manometer and recorded graphically on a drum.

94. Tonometer devised by C. S. Roy and modified by W. H. Gaskell.

Lent by the Government Grant Committee of the Royal Society. 1888.

The instrument consists essentially of two cylindrical vessels communicating by a tube. The smaller is of brass, and is closed below by a membrane and piston, connected with a light lever whereby the vertical motions of the piston can be inscribed upon a drum. The stopcock at the top admits of this cylinder being filled with oil. The larger cylinder is of glass, and is closed at the top by a tightly fitting vulcanite stopper in which are five holes of exactly the same size into which different pieces of apparatus can be fixed. Usually these are as follows:—(1) A cannula some 3 mm. in diameter, which is tied into the venous sinus of the frog's heart under examination; (2) a smaller cannula, which is inserted into one of the aortic trunks; by means of these two the heart is fed with an artificial solution of blood; (3) a metal holder sustaining a piece of cork to which various portions of the apparatus can be attached by pins; (4) an electrode of peculiar construction; it is a glass tube "which is hermetically sealed at both ends, and carries within it a pair of platinum electrodes, bent at their extremities into the form of a loop. Two very small holes are blown exactly opposite to each other in the middle of this tube, and the electrodes are fixed within it so that the line joining the two holes is just below the lowest point of the electrodes. Through these holes the vagus nerve can be drawn by a thread attached to its extremity, and by pinning the end of the thread on to the cork" above alluded to the nerve will always remain in contact with the electrodes. Since the glass tube is closed above and below the air within it does not escape, and hence, though the cylinder be filled with normal salt solution, the nerve is in the air, and there is no escape of current; (5) a tightly fitting plug which allows the quantity of fluid in the cylinder to be regulated.

The apparatus was used by Dr. W. H. Gaskell in his experiments of the vagus nerve, and a full description of it is given in *Phil. Trans.* 1882, p. 1019, pl. 70, figs. 22, 23.

95. Time markers to be used with syphon tubes for recording. Employed by Dr. Gaskell in his researches. See *Phil. Trans.* 1882.

Lent by the Government Grant Committee of the Royal Society. 1888.

96. Cardiograph, devised by Marey, for recording the movements of the heart.

Lent by the Biological Laboratory, Royal College of Science. 1878.

This instrument consists of two essential parts. The first is a kind of flat tripod which rests upon the wall of the thorax over the heart, and is fastened by a band passing round the body. Between these three feet is a drum with an india-rubber membrane, which is actuated by a knob which can be made by properly adjusting the height and position of the tripod to lie upon the fifth intercostal space just over the heart's apex. The interior of the drum is connected with a long caoutchouc tube, by means of which it communicates with the second part of the apparatus.

This consists of a drum, smaller than the one just mentioned, with a stem, by which it can be held in a support. It has an india-rubber membrane, to which is fixed a lever, the end of which bears a point for writing on a revolving drum. The effect of this arrangement is that the motions of the heart produce changes of pressure in the tube, and these again are translated into movements of the lever and recorded upon the surface of the drum.

97. Sphygmograph, devised by Marey, for the demonstration of pulse movements.

Lent by the Biological Laboratory, Royal College of Science. 1878.

The instrument is fastened around the wrist so that the end of a spring lever rests upon the radial artery and shares its pulsations. The movements of this spring are magnified by another light lever, which carries at its extremity a sharp tracing point. This point writes upon a blackened strip of paper, which is carried forwards by clockwork as the lever moves up and down.

98. Drawings of the Pletismograph, devised by Dr. A. Mosso, of Turin, for exhibiting the variations in volume in separate organs or individual limbs.

Given by Dr. A. Mosso. 1877.

The organ (usually a liver or kidney of some small animal) is immersed in a closed vessel full of oil and its vessels supplied with defibrinated blood at a pressure which can be determined by the experimenter. With the vessel of oil is connected a tube, through which any excess due to the expansion of the organ passes out and falls into a counterpoised vessel connected with a pen, which writes on a revolving drum. Thus the changes in the volume of the organ are registered. In the case of the changes in the volume of a limb being measured it is passed into the open end of a tube and made water-tight by a band of caoutchouc. The rest of the apparatus is arranged on the same principle as before.

iv. *Apparatus for Experiments on the Respiratory Organs.*

99. Pulmonograph, devised by Marey, for the investigation of respiratory movements in man.

Lent by the Biological Laboratory, Royal College of Science. 1878.

This instrument is essentially similar to the cardiograph above described, except that it registers the movements of the wall of the chest. The apparatus passes round the chest and rests firmly against the middle of the back. A knob which actuates the membrane of a drum rests upon the front wall of the chest, and its movements are transferred to a small drum with a writing lever, precisely as in the cardiograph.

100. Double stethograph, devised by Dr. Riegel.

E. 246.—1877.

Made by A. Weber, Würzburg.

The instrument consists of a framework supporting two pads, which rest one upon either side of the chest; these are connected with levers writing upon a strip of paper carried forward by clockwork, so that the respiratory motions of the two sides of the chest can be compared simultaneously.

101. Voit's apparatus for investigating the gases given off in the respiration of small animals. In glass case 9 ft. 7 in. \times 3 ft. 8 in. \times 3 ft. 3 in.

E. 247.—1877.

Made by C. Stollnreuther, Munich.

The animal under investigation is placed in the small glass chamber, through which a current of air is slowly drawn by means of the water-wheel. The air passes through meters, which determine its quantity, and through drying tubes to remove the aqueous vapour, and tubes containing potash to remove the carbonic acid, by means of which the amounts of these constituents are determined.

102. Drawings (4) of apparatus for testing the products of the perspiration of animals. The larger apparatus is intended for the heavier quadrupeds; the smaller serves for researches on smaller mammals and birds.

Lent by Professor Dr. Ignaz Moser, Vienna. 1876.

This apparatus is similar in principle to No. 101.

v. *Apparatus for Experiments in the Digestive Organs.*

103. Kronecker's incubator, with diffusion apparatus for experiments in artificial digestion.

Made by Warmbrünn, Quilitz, & Co., Berlin.
E. 175.—1877.

The outside metal cylinder is filled with water, and by means of a gas jet and regulator kept constantly at any desired temperature; it may be emptied by a stop-cock. Within the metal is a glass cylinder, which fits into the centre of the latter and rises up through its lid. From its lower end a glass tube passes out horizontally through the metal cylinder and ends in a glass stop-cock. The funnel contains a filter of parchment paper, through which the products of digestion diffuse. The upper portion of the glass serves as a kind of Mariotte's bottle for constantly washing away the products of digestion.

104. Bunsen's filtering pump, by Desaga, Heidelberg.

Lent by the Biological Laboratory, Royal College of Science. 1878.

In this apparatus suction is produced by water flowing drop by drop into a tube of such a diameter that the drops completely close it. The tube is connected with the interior of a flask, through the cork of which passes the neck of a funnel containing the liquid to be filtered. The air is carried down between the drops of water, and if a long tube be used a considerable pressure can be obtained.

vi. *Apparatus for Experiments on the Sensory Organs.*

105. A set of five resonance globes with case of tuning forks.

Lent by the Biological Laboratory, Royal College of Science. 1878.

Each globe is of such a size that it will resound to a note of a particular pitch, and hence permit it to be identified when sounded along with others. In this way the harmonics or over-tones of a compound note may be recognised.

106. Phakoscope for determining the changes in the form of the human crystalline lens during accommodation, designed by Professor Helmholtz. Made by Sittel, Heidelberg.

Lent by the Biological Laboratory, Royal College of Science. 1878.

The instrument consists of a stand supporting a flat triangular box, the corners of which are cut off and occupied by various apertures. One of these is a round hole for the eye of the observer, the other a similar hole for the observed eye; the third consists of two small separated holes each covered by a small prism. In addition to these a small square aperture is provided in the flat side of the box opposite the observed eye. A candle is placed opposite the two prisms, when the observer sees its reflection from the surfaces of the lens of the observed eye. This is first accommodated for distant objects, and afterwards for a pin placed in the hole immediately opposite; the changes in the dimensions and positions of the reflected images of the candle flame give the means of determining the alterations in the curvature of the lens.

B. ANTHROPOMETRIC APPARATUS.

107. Craniometer, an instrument for taking measurements of the human cranium.

Lent by the late George Busk, F.R.S. 1876.

The instrument is constructed on the principle of the common shoemaker's gauge, and consists of a straight stem about 12 inches long, having an arm jointed to it at one end, which can be erected so as to stand at a right angle, and a second arm which can be slid up and down the stem, and is also capable of being erected to a right angle, so as to stand exactly parallel with the former. The stem and arms are graduated on one side in inches and tenths, and on the other in centimetres and millimetres. The graduation of the stem begins at the fixed arm, and that on the arms at the stem. In order to render the instrument capable of taking radial measurements, a conical peg can be slipped upon each of the arms, the points of which are inserted into the external auditory foramina. The radial distance from the centre of the foramen can be thus measured to any point on the periphery of the skull in the mesial plane, the distance being read off on the short arms.

108. Craniometer designed by Dr. F. W. Spengel.

E. 238.--1877. Made by A. Wichmann, Hamburg.

This apparatus consists of a flat brass table with wooden legs large enough to hold the skull to be examined, and certain movable pieces on each side of it. In the middle of each end is an upright piece which can be moved to and from the centre of the table by means of a fine screw, the distance from the centre being read off on a graduated scale. The skull to be measured is placed vertex downwards upon the table and carefully levelled by small thumbscrews projecting upwards through the

table for the purpose ; the uprights just mentioned are pushed up against it and thus the length is measured. The breadth is determined by means of two vertical plates which approach the centre by means of screws. They consist of rather large glass plates ruled in squares so that it is easy to measure the relative position of the auditory openings. The height of the skull is read off by a horizontal limb moving on the posterior upright, whilst two horizontal bars on the anterior upright furnish the means of determining the facial angle. A small movable protractor serves for reading off the slope of the foramen magnum.

109. Craniometer designed by Prof. Virchow for easy portability.

E. 239.—1877. *Made by A. Wichmann, Hamburg.*

A brass rod graduated in millimetres bears a fixed upright piece at one of its ends. A block which bears a similar graduated upright slides along it, very much as in the ordinary shoemaker's measure.

110. Callipers designed for portability by Prof. Virchow.

E. 240.—1877. *Made by A. Wichmann, Hamburg.*

Each limb of the callipers has a hinge in it so that it can be bent upon itself, and thus the instrument can be packed into half the space it would otherwise occupy.

111. Measuring scale devised by Prof. Virchow for reading the divergence of the callipers.

E. 241.—1877. *Made by A. Wichmann, Hamburg.*

The scale is of brass graduated into centimetres and millimetres ; at the zero line is a notch to receive the extremity of one arm of the callipers. The whole folds by a hinge in the centre for convenience in packing.

112. Instrument for measuring simultaneously the breadth of the extended arms and the height.

Lent by the late Joseph Bonomi. 1876.

According to the description furnished by the inventor of this instrument the normal proportion of the human frame is that the measure of the distance from the extremity of one hand to the extremity of the other when the arms are extended should be the same as that from the top of the head to the sole of the foot, and any departure from this normal proportion furnishes a means of individual identification.

The purpose of the instrument is to obtain these two measurements simultaneously.

It consists of two laths of wood fixed at a certain angle against a wall. Down the centre of each lath is a groove in which slides an index to show the required measurements. The third index below is for the purpose of ascertaining with great nicety the law of growth.

The instrument was designed to be used for the identification of persons.

C. SPECIMENS AND DISSECTIONS.

113. Natural History Collection prepared at the Pedagogical Museum, St. Petersburg, for the use of Russian schools.

From the Pedagogical Museum, St. Petersburg.
E. 681, &c.—1877.

The collection consists of the following stuffed animals mounted on stands:—

- Swallow.
- Starling.
- Cock.
- Kestrel.
- Jay.
- Capercaillie.
- Group illustrating the development of a sea swallow.
- Frog.
- Tortoise.

The following osteological specimens:—

- Skeleton of Dog.
- Skull of Dog.
- Skull of Hare.
- Skeleton of Common Fowl.
- Skull and Sternum of Fowl.
- Skeleton of Turkey.
- " " Eagle.
- " " Pelican.
- " " Tortoise.
- " " Frog.
- " " Bat.

Also—

- Wing of a duck, mounted on board.
- Eggs, a set of 10, in glass case.
- Shells, a set of 23, in glass case.
- Entomological collection, in 14 small glazed cases.
- Rostrum of a saw fish.

[The more important of the above items have been catalogued in their proper places below.]

114. Natural History Collection for use in illustrating object lessons.

Presented by the Belgian Government.

E. 67 to 101.—1862.

The collection consists of the following stuffed animals mounted on stands :—

Birds, 10 species.

Fishes, 6 species.

Snakes, 2 species.

A Chameleon.

A Newt, and 4 species of insects, preserved in spirit.

Also of the following osteological specimens :—

Mounted skeletons of,—

Monkey.

Rat.

Cat.

Two Birds.

Bat.

Tortoise and Snake.

Mole.

Frog and Fish.

[Several of these are also described hereafter.]

115. Model of a cupboard to exhibit jars containing museum preparations.

Lent by the late Professor Esmark, Christiania. 1876.

The bottles containing the preparations stand on the circumference of circular shelves which are supported upon a vertical axis. This can be rotated by a handle at the bottom of the case so as to bring all the jars successively into view. One of the sets of shelves has been divided in the middle vertically to show its construction.

116. Stuffed animals.

Birds, seven species from the Pedagogical Museum, St. Petersburg. E. 695 to 701.—1877.

Birds, 10 species. Presented by the Belgian Government. E. 75 to 84.—1862.

Tortoise and Frog. From the Pedagogical Museum, St. Petersburg. E. 702 and 703.—1877.

Snakes, two species, and Chameleon. Presented by the Belgian Government. E. 90 to 92.—1862.

Fishes, six species. Presented by the Belgian Government. E. 85 to 89 and 101.—1862.

117. A collection of embryos of the Sturgeon (*Acipenser ruthenus*), and a number of microscopic sections and other preparations, chiefly from the same species.

Presented by Dr. P. Ovsiannikov, St. Petersburg.

E. 489 and 490.—1877.

The first artificial fecundation of the eggs of this fish was made by Dr. P. Ovsiannikov, in the year 1869, at Simbirsk on the Volga, and in the same year a small quantity was brought by him to St. Petersburg. The embryos exhibited have grown up in an aquarium in the laboratory of Dr. Ovsiannikov.

There are sixteen bottles which contain embryos at various stages, from a day to a year old; also 13 microscopic slides illustrating various features in the embryos. In addition to these are half-a-dozen preparations illustrating points in the developmental history of the axolotl, as well as a mounted *Coregonus*-embryo showing the central nervous system and mounted microscopic section of the egg of *Petromyzon fluviatilis*, showing the formation of the alimentary canal.

118. Collection of 100 species of recent shells, illustrative of Woodward's "Manual of the Mollusca."

Exhibited by Bryce M. Wright. 1877. Price 3l.

119. Collection of about 300 species of British marine shells, illustrative of Dr. J. Gwyn Jeffreys's "British Conchology."

Exhibited by the late R. Damon. 1876.

120. Collection of 120 species of British land and fresh-water shells, illustrative of Dr. J. Gwyn Jeffreys's "British Conchology."

Exhibited by the late R. Damon. 1876.

121. Collection of shells for teaching purposes.

E. 51.—1862. *Presented by the Belgian Government.*

122. A small collection of 23 common species of shells for school purposes.

From the Pedagogical Museum, St. Petersburg.

E. 707.—1877.

123. Collectanea entomologica. An introductory course of study of insects, arranged in systematic order. In a book-shaped glazed case.

E. 1.—1858. *Presented by the Entomological Society.*

124. Entomological collection of about 100 different species in small glazed case for teaching purposes.

E. 42.—1862. *Presented by the Belgian Government.*

125. A series of specimens of insects, with enlarged drawings of the smaller species, and illustrations of the

work of insects. Also directions for the destruction of pests. Prepared for the Science and Art Department by the late Andrew Murray, F.L.S.

A catalogue of these has been issued by the Department, and a handbook on one section (Aptera) was prepared by Mr. Andrew Murray in 1877, and published by Chapman and Hall.

[This collection is in course of re-arrangement and hence is not catalogued in detail. A portion of the collection which has been re-mounted and arranged on a botanical basis will be found under Botany, *vide* p. 73, *postea*.]

126. Ten slides containing each 50 named species of Foraminifera. *Prepared by F. G. Pearcey.*

E. 13.—1889.

127. A series of dissections and mounted organs of various animals from the Biological Laboratory, Royal College of Science.

Heart of the dog with the principal cavities opened to show the valves. E. 53.—1878.

Cæcum of the intestine of the dog. E. 54.—1878.

Brain of the cat. E. 55.—1878.

Heart and lungs of the cat. E. 56.—1878.

Stomach, liver, and spleen of the cat, with the vessels injected. E. 57.—1878.

Brain of the sheep, mounted whole. E. 58.—1878.

Brain of the sheep in three sections, to show its chief component parts. E. 59.—1878.

Side dissection of the rabbit. E. 11.—1879.

Arterial system of the rabbit, injected. E. 60.—1878.

Side dissection of the pigeon. E. 61.—1878.

Side dissection of the frog. E. 62.—1878.

Dissection of the frog, from the front aspect. E. 63.—1878.

Side dissection of the frog, with the vessels injected. E. 64.—1878.

Dissection of the skate, from below. E. 12.—1879.

Dissection showing the nervous system of the skate. E. 13.—1879.

Dissection showing the arterial system of the skate, injected. E. 14.—1879.

Shell of the fresh-water mussel. E. 66.—1878.

Dissection of the fresh-water mussel. E. 67.—1878.

Skeleton of the lobster, disarticulated (male). E. 15.—1879.

Skeleton of the lobster, disarticulated (female). E. 16.—1879.

Side dissection of the lobster. E. 65.—1878.

Dissection showing the nervous system of the crayfish. E. 17.—1879.

Crayfish, mounted to show its external characters. E. 18.—1879.

128. A dried dissection of a rabbit in which the principal arteries have been injected.

Exhibited by Moore Bros., 1887. Price 2l. 10s.

129. Exoskeleton of a king crab (*Limulus*), disarticulated and mounted.

Exhibited by Moore Bros., 1887. Price 3l. 15s.

130. The exoskeleton of a lobster, disarticulated and mounted on a stand.

Exhibited by Moore Bros., 1887. Price 3l. 10s.

131. The exoskeleton of a crab, similarly mounted, with the carapace of another specimen opened to show the internal structure.

Exhibited by Moore Bros., 1887. Price 3l. 10s.

D. OSTEOLOGICAL SPECIMENS.

i. Mounted articulated Skeletons.

132. Human skeleton, articulated and mounted on a stand.

The skull can be separated into parts by means of sections, and the femur has been divided to show its internal structure.

E. 153.—1874.

133. Foetal skeleton, complete, with natural ligaments.

Exhibited by H. K. Lewis, 1890. Price 2l. 2s.

134. Skeleton of a Gorilla.

E. 71.—1888.

Prepared by Moore Bros.

135. Skeleton of a Chimpanzee.

E. 72.—1888.

Prepared by Moore Bros.

136. Skeleton of a Baboon.

Exhibited by Moore Bros., 1887. Price 5l.

137. Skeleton of a Monkey.

E. 67.—1862.

Presented by the Belgian Government.

138. Skeleton of a Lemur (*Chirogaleus pusillus*).
E. 183.—1888.

139. Skeleton of a Dog.
From the Pedagogical Museum, St. Petersburg.
E. 686.—1877.

140. Skelton of an Arctic Fox.
E. 74.—1888. *Prepared by Moore Bros.*

141. Skeleton of a Cat. Bisected down the middle line; the one half is mounted and the other is exhibited in portions.
Exhibited by Moore Bros., 1887. Price 6l. 6s.

142. Skeleton of a Cat.
E. 68.—1862. *Presented by the Belgian Government.*

143. Skeleton of a Coati (*Nasua narica*).
E. 27.—1888. *Prepared by E. Gerrard, jun.*

144. Skeleton of an Otter (*Lutra japonica*).
E. 28.—1888. *Prepared by E. Gerrard, jun*

145. Skeleton of a Bat.
E. 97.—1862. *Presented by the Belgian Government.*

146. Skeleton of a Bat.
From the Pedagogical Museum, St. Petersburg.
E. 690.—1877.

147. Skeleton of a Hedgehog.
E. 73.—1888. *Prepared by Moore Bros.*

148. Skeleton of a Mole.
E. 93.—1862. *Presented by the Belgian Government.*

149. Skeleton of a Squirrel.
E. 75.—1888. *Prepared by Moore Bros.*

150. Skeleton of a Rat.
E. 95.—1862. *Presented by the Belgian Government.*

151. Skeleton of a Dorcas Gazelle.
Exhibited by Moore Bros., 1887. Price 4l. 10s.

152. Skeleton of a Tasmanian Wolf (*Thylacinus* sp.).
E. 21.—1888. *Prepared by E. Gerrard, jun.*

- 153.** Skeleton of an Opossum (*Didelphys Azaræ*).
E. 23.—1888. *Prepared by E. Gerrard, jun.*
- 154.** Skeleton of an Opossum (*D. derbianus*).
E. 24.—1888. *Prepared by E. Gerrard, jun.*
- 155.** Skeleton of a Wombat (*Phascolomys* sp.).
E. 25.—1888. *Prepared by E. Gerrard, jun.*
- 156.** Skeleton of a Kangaroo.
E. 76.—1888. *Prepared by Moore Bros.*
- 157.** Skeleton of a Platypus (*Ornithorhynchus anatinus*).
E. 31.—1888. *Prepared by E. Gerrard, jun.*
- 158.** Skeleton of a Porcupine ant-eater (*Echidna setosa*).
E. 26.—1888. *Prepared by E. Gerrard, jun.*
- 159.** Skeleton of a Common Fowl.
From the Pedagogical Museum, St. Petersburg.
E. 681.—1877.
- 160.** Skeleton of a Turkey.
From the Pedagogical Museum, St. Petersburg.
E. 685.—1877.
- 161.** Skeleton of an Eagle.
From the Pedagogical Museum, St. Petersburg.
E. 683.—1877.
- 162.** Skeleton of a Falcon.
E. 77.—1888. *Prepared by Moore Bros.*
- 163.** Skeleton of a Screamer (*Chauna derbiana*).
E. 20.—1888. *Prepared by E. Gerrard, jun.*
- 164.** Skeleton of a Pelican.
From the Pedagogical Museum, St. Petersburg.
E. 684.—1877.
- 165.** Skeleton of a Penguin.
E. 78.—1888. *Prepared by Moore Bros.*
- 166.** Skeleton of a Rhea.
E. 79.—1888. *Prepared by Moore Bros.*

167. Skeletons of two birds.

Presented by the Belgian Government.
E. 98 & 99.—1862.

168. Skeleton of a Tortoise.

From the Pedagogical Museum, St. Petersburg.
E. 688.—1877.

169. Skeleton of a Tortoise.

E. 96.—1862. *Presented by the Belgian Government.*

170. Skeleton of a Lizard (*Cyclodus nigroluteus*).

E. 30.—1888. *Prepared by E. Gerrard, jun.*

171. Skeleton of a Stump-tailed lizard (*Trachydosaurus rugosus*), with the skin separately mounted.

E. 29.—1888. *Prepared by E. Gerrard, jun.*

172. Skeleton of a Tuatara lizard (*Sphenodon punctatum*).

Prepared by Moore Bros.
E. 80.—1888.

173. Skeleton of a Snake.

E. 69.—1862. *Presented by the Belgian Government.*

174. Skeleton of a Frog.

From the Pedagogical Museum, St. Petersburg.
E. 689.—1877.

175. Skeleton of a Frog.

E. 94.—1862. *Presented by the Belgian Government.*

176. Skeleton of a Siren (*Siren lacertina*).

E. 32.—1888. *Prepared by E. Gerrard, jun.*

177. Skeleton of a Fish.

E. 100.—1862. *Presented by the Belgian Government.*

178. Skeletons of a cat, duck, and codfish, arranged side by side to show the corresponding or homologous parts of the three types of skeleton.

Prepared for the Science and Art Department.
E. 144.—1874.

ii. *Skulls and other Bones.*

179. Human skull.

E. 102.—1862. *Presented by the Belgian Government.*

The calvaria has been separated by a horizontal section.

180. Human skull.

From the Pedagogical Museum, St. Petersburg.

E. 680.—1877.

The calvaria can be lifted off; then, after removing the mandible, the two halves can be separated by a vertical section.

181. Articulated human skull. The calvaria can be removed, and the remaining portion is bisected to the left of the middle line.

Exhibited by H. K. Lewis, 1890. Price 2l. 10s.

182. Preparation of the human temporal bone, bisected through the plane of the middle ear to show its contained ossicles and internal anatomy. The course of the chorda tympani nerve is indicated by a bristle, and counterparts of the tensor tympani and stapedius muscles are introduced in wax.

Exhibited by H. K. Lewis, 1890. Price 16s.

183. Skull of a dog.

From the Pedagogical Museum, St. Petersburg.

E. 687.—1877.

184. Skull of a hare.

From the Pedagogical Museum, St. Petersburg.

E. 691.—1877.

185. Skull of a sheep, disarticulated and mounted.

Exhibited by Moore Bros. 1887. Price 3l. 10s.

186. Skull of Tasmanian wolf.

E. 22.—1888.

Prepared by E. Gerrard, jun.

187. Skull of domestic fowl, disarticulated and mounted.

Exhibited by Moore Bros. 1887.

Price 3l.

188. Skull and sternum of domestic fowl.

From the Pedagogical Museum, St. Petersburg.
E. 682.—1877.

189. Skull of codfish, disarticulated and mounted.

Exhibited by Moore Bros. 1887. Price 4l.

190. The manus and pes of a chimpanzee, disarticulated and mounted on stands. *Prepared by Moore Bros.*
E. 81, 82.—1888.

191. The manus and pes of a baboon, similarly mounted. *Prepared by Moore Bros.*
E. 83, 84.—1888.

192. The manus and pes of a bear, similarly mounted. *Prepared by Moore Bros.*
E. 85, 86.—1888.

193. The manus and pes of a turtle, similarly mounted. *Prepared by Moore Bros.*
E. 87, 88.—1888.

194. Human hand and foot, articulated and mounted on a board. *Price 7s. each.*
Exhibited by Rigg's Technical Education Appliances Co.
1889.

E. MODELS.

i. Human Anatomy.

195. Model, in papier-mâché, of flayed human subject, natural size, externally sexless.

Made by Montaudon (late Dr. Auzoux).
E. 29.—1890.

(The model is made in 27 leading pieces, the nature of each of which is indicated in italics with its corresponding number, catalogued in order for removal on dissection.)

* * * *To be taken to pieces only by the attendant in charge.*

A.—Intact Figure.

RIGHT SIDE.—Superficial muscles and blood-vessels, with the exception of the sterno-cleido-mastoid (the head of which is alone indicated) and platysma myoides.

Origin of serratus magnus seen on removal of (i.) *right arm*.

INCIDENTAL.—The fascia lata, parotid gland, Stenson's duct.

LEFT SIDE.—Deep muscles, blood-vessels, and nerves, including those of plantar surface of foot (seen on removal of (ii.) *left hind limb*) and the extrinsic muscles of the larynx; together with the course and distribution of the great nerve plexuses and of the cervical sympathetic.

SPECIAL.—Dorsal rami of cervical spinal nerves (and of the anterior thoracic ones, on removal of (iii.) *left arm*).

INCIDENTAL.—Relationships of rectus abdominis muscle to the internal oblique aponeurosis, and of the biceps tendon to the humerus and shoulder girdle. The orbit and the naso-lachrymal ducts.

B.—The Thoraco-Abdominal Wall and General Disposition of the Thoraco-Abdominal Viscera.

(iv.) *The thoraco-abdominal wall*. Inner surface shows insertions of diaphragmatic and relations of transversalis abdominis muscles, (on the left side) relationships of internal intercostal, rectus abdominis, and pyramidalis muscles, and of the epigastric blood-vessels. The triangularis sterni is represented on the right side.

THORACO-ABDOMINAL VISCERA.—SPECIAL, THORAX.—Left lung in part dissected, to show the smaller bronchial and vascular ramifications (represented in the thallus of the "Reindeer Moss," *Cladonia rangiferina*).

SPECIAL, ABDOMEN.—Stomach and ileum laid open, to show the characters of their lining membranes. Head of colon laid open, to show the ileo-colic and cœcal orifices with their related valves.

INCIDENTAL.—Positions of the gall-bladder, and (right side) of Poupart's ligament in relation to the abdominal muscles, are shown. On the left side the course of the external iliac blood-vessels and nerves is indicated, in relation to the hip girdle. The innominate vein, the thyroid body, and, in relation to the former, the thoracic duct, are best seen at this stage.

C.—The Head and Neck.

THE BRAIN.—Exposed on removal of (v.) *the calvaria*.

(vi.) *Entire brain*, external characters. Shows also the roots of the cranial nerves and the courses of the great arteries of the base.

Left half of brain. Portions removable in order to show (*vii.*) *the strice longitudinales and corpus callosum* (inner and outer aspects).

(*viii.*) *The relations and contents of the lateral ventricle*, as viewed from above.

(*ix.*) *The course of the fornix and leading commissural tracts*, as seen from within, together with the peduncles of the cerebellum.

Reducible to (*x.*) *longitudinal section* (right half as seen from within).

THE CALVARIA (removed at *v.*).—Right side. Superficial muscles and blood-vessels.

Left side. Cranial roof and origin of temporal muscle.

Interior. The dura mater and superior longitudinal sinus.

INTERIOR OF CRANIUM.—Dura mater, with enclosed great blood sinuses in relation to the Torcula Herophili (laid open).

Portions of leading cranial nerves of left side indicated, in relation to their exits. Distribution of middle meningeal artery shown.

SECTIONAL VIEWS OF HEAD AND NECK.—On removal of (*xi.*) *anterior half of left side*. The buccal, nasal, pharyngeal, and laryngeal cavities, with the trachea and œsophagus. Shows the septum nasi, and the course of the olfactory and naso-palatine nerves.

Surface view of neck. The longus colli muscles; cervical sympathetic, with superior cervical ganglion and the rami communicantes of the cervical nerves.

On removal of (*xii.*) *posterior half of left side*. Seen, in addition to the above-named structures and parts, median longitudinal section of cervical vertebræ; cervical spinal cord, with roots of cervical spinal and spinal-accessory nerves.

ANTERIOR HALF OF HEAD AND NECK, LEFT SIDE (removed at *xi.*).—SECTIONAL VIEW.—Internal anatomy of nasal chamber, with distribution of olfactory and nasal branches of palatine nerves and of the ethmoidal arteries.

The muscles of the tongue are indicated in detail, and as slightly separated, to display the course of the lingual artery and hypoglossus nerve.

Certain muscles of the palate and larynx are represented, as seen after removal of the pharyngeal mucous membrane.

DORSAL ASPECT.—Constrictor pharyngeus muscles, with general distribution of carotid artery and vagus nerve.

After removal of (*xiii.*) *posterior pharyngo-œsophageal wall*. The levator palati, stylo-thyroglossus, and crico-arytenoid muscles, with adjacent nerves and arteries, as seen from within.

POSTERIOR HALF OF HEAD AND NECK, LEFT SIDE (removed at *xii.*).—OUTER ASPECT.—Shows especially ansæ of cervical nerves and extra-cranial course of vertebral artery.

INNER ASPECT.—Median longitudinal section of cervical vertebræ; with interior of cervical neural-canal, exits for cervical spinal nerves, and course of longitudinal spinal veins.

(xiv.) *Right half of head and neck (minus calvaria and brain) after removal from body.*

Posterior aspect shows constrictor laryngis muscles, and the course of the internal carotid artery and internal jugular veins. For other aspects, cf. *suprà*.

D.—Thoracic Viscera.

(xv.) *Left lung.* Inner aspect after removal shows cut ends of pulmonary vessels and trachea, at points of communication with lung substance. The trunks of the left phrenic nerve and superior phrenic artery are shown, adherent to the lung.

(The course of the arch of the aorta is best seen at this stage.)

(xvi.) *The heart, trachea, and œsophagus, with branches of the vagus nerve related thereto.*

The course of the pulmonary and œsophageal branches of the vagus discernable on turning forwards (xvii.) *the œsophagus.*

The internal anatomy of the heart is to be displayed by withdrawing (xviii.) *the right auricle and ventricle.*

Contents of each ventricle visible on turning back flap of its inner wall.

Coronary blood-vessels and cardiac nerves indicated at various points.

(xix.) *The right lung.* On its inner aspect, the roots of the pulmonary vessels and trachea are shown, in relation to the lung substance and to the reflected layer of the pleura.

E.—The Diaphragm.

The diaphragm (xx.) can be removed in toto. Its inner aspect shows the course and distribution of the inferior phrenic nerves and blood-vessels, together with the semilunar ganglia and portions of the great splanchnic nerves.

F.—The Abdominal Viscera.

(xxi.) *The transverse and descending colon and ileum,* removable as one. Outer aspect shows ileum and head of colon laid open, to display their lining membrane, &c. (cf. § B.). Inner aspect shows the appendix vermiformis, and distribution of the superior-mesenteric artery, with its accompanying veins and lacteals.

(xxii.) *The urinary bladder,* with certain related structures. Its posterior aspect embraces the prostate, the bases of the ureters and vasa deferentia with the receptacula seminis. On

the left side, portions of the vesicular and prostatic nerves are shown, with their accompanying arteries.

Sectional aspect shows prostate and urethra in median longitudinal section, and the apertures of the ureters.

(xxiii.) *The descending colon and rectum.* The distribution of the inferior mesenteric artery and vein are shown, with the course of their accompanying nerves and lacteals.

(xxiv.) *The stomach, duodenum with its appended glands, kidneys, ureters, and spleen ; with related blood-vessels, &c.*

The stomach is laid open to show the characters of its interior (cf. § B.). It, together with the duodenum and pancreas, can be removed, to show the course of the gastro-duodenal nerves and blood-vessels and (from the dorsal aspect) the bile and pancreatic ducts—the latter as laid bare on dissection of its gland.

(xxv.) *The liver, spleen, and kidneys, with the supra-renal bodies and proximal portions of the ureters* (remain over after removal of xxiv.).

VENTRAL ASPECT.—Seen, in addition to general characters, the great systemic arteries and veins in relation, the distribution of the portal veins and of the splenic and hepatic branches of the cœliac artery. There are shown, in addition, the origin of the superior mesenteric artery, the course and relationship of the bile-ducts, the solar plexus, and the leading trunks of the lacteal system.

DORSAL ASPECT.—The blood-vessels of the kidneys and supra-renal bodies, together with the course of the hepatic portion of the inferior cava and the mode of formation of the intestinal lymphatic trunk, are shown in detail.

The right kidney ; after removal of (xxvi.) its ventral half. The internal anatomy, the mode of origin of the ureters, with the great vessels and nerves in relation to the hilum are laid bare.

G.—The Trunk, after Evisceration and Removal of the Independently Constructed Parts. (= xxvii.).

GENERAL.—The relationships of the vertebræ and ribs, with their ligaments and the dorso-lateral muscles. On the right side the superficial endo-skeletal muscles, fascia lata, Poupart's ligament, iliac vessels, and nerves are shown ; on the left are indicated the course and distribution of the sympathetic and spinal nerves, as seen on removal of the endo-skeletal muscles.

SPECIAL.—The origin of the great splanchnic nerves ; the insertion of the pillars of the diaphragm ; the course of the azygos vein, and of the intercostal veins and arteries ; the course, general relationships, and factors of the thoracic duct, with the receptacula chyli.

196. Model of a man about 2 feet high, with the skin removed and many of the superficial muscles dissected out.

From the Pedagogical Museum, St. Petersburg.
E. 661.—1877.

The calvaria can be lifted off to expose the brain, which can be taken out; one hemisphere is still enclosed in the dura mater, the other uncovered; the two halves separate to show in section the corpus callosum, pons Varolii, and cerebellum. The right side of the face may be removed to show sections of the nose, mouth, pharynx, trachea, and œsophagus. The two lungs, the heart and great vessels, and trachea are movable. In the heart, apertures have been made into both ventricles and the right auricle to show the valves. The diaphragm, liver, and stomach can be removed separately; as also the intestine and the descending colon, with the rectum and bladder. On the right side the gluteus maximus and gastrocnemius muscles are movable.

197. Model of a dissection of the right side of the human head and neck. Made by Rammé and Sodtmann, Hamburg.

Exhibited by G. Gill & Co. 1878. Price 18s. 6d.

The superficial muscles, vessels, and nerves are shown. The sterno-cleido-mastoid can be removed to show the course, relations, and chief branches of the common carotid artery and jugular vein.

198. Model of the anterior part of the human head.

From the Pedagogical Museum, St. Petersburg.
E. 669.—1877.

The posterior wall of the pharynx is movable so as to show the connexions of the mouth and nose and the position of the epiglottis. The upper half of the model can be lifted off to exhibit the cavity of the mouth.

199. Model of the human head in vertical section, natural size. Made by Rammé and Sodtmann, Hamburg.

Exhibited by G. Gill & Co. 1878. Price 15s.

The bones of the skull, cerebrum, tentorium, corpus callosum, pons Varolii, and medulla oblongata are shown, along with the cavity of the mouth and the tongue.

200. Model showing the head and neck in vertical section.

From the Pedagogical Museum, St. Petersburg.
E. 663.—1877.

The larynx is movable; the model does not aim at giving minute details.

201. Model of the brain.

E. 12.—1862. *Made by the late Dr. Auzoux, Paris.*

The upper half of each hemisphere is movable to show the upper surface of the corpus callosum. On the left side a portion of the side wall can be taken out to expose, first, the fibres of the corpus callosum, and after removal of these the cavity of the lateral ventricle, with its corpus striatum and hippocampus minor. The temporo-sphenoidal lobe can be removed to show the end of this latter as well as the optic tract. The under part of the frontal lobe lifts on a hinge and renders visible the fibres forming the pillars of the fornix. The two hemispheres can be separated so as to exhibit the interior of the third ventricle, the septum lucidum, the pineal body, and the optic thalamus. On the left side this last, with the fornix, corpus striatum, choroid plexus, and corpus albicans, is also seen by lifting off another layer of the model. The middle part of the fornix lifts to show the smooth surface of the optic thalamus below it. On this side, moreover, the lower part of the temporo-sphenoidal lobe can be removed to show the hippocampus major and the corpus fimbriatum. The cerebellum on being removed exposes the fourth ventricle, and it is provided with a median section, to show the arbor vitæ and a section through its left lobe. A portion of the pons Varolii has been removed on the right side to show the fibres passing up to the cerebrum. On the back of the medulla oblongata two pieces are loose to show its internal structure.

202. Model to show the form and relations of the dura mater, enlarged.

E. 13.—1862. *Made by the late Dr. Auzoux, Paris.*

On the left side the wall of the skull is retained in the lower part; above it is the dura mater which lines the vault of the skull. In the middle line is the superior longitudinal sinus which has been opened to show the contained trabeculæ. On the right side a large window has been made to show the form of the cavity and the receptacles for the various parts of the brain. The upper part of the dura mater and the falx cerebri lift off, leaving the tentorium cerebelli, which can be removed in its turn, to show the cavity for the cerebellum.

203. Model of the human brain, natural size.*Exhibited by R. M. Cameron and Son. 1879.*

The upper halves of both hemispheres are movable; the left to the level of the upper surface of the corpus callosum so as to demonstrate the arrangement of its fibres, the right as far as the cavity of the lateral ventricle, the descending cornu of which with its contained hippocampus minor may be exposed by removing a small block lower down, or a somewhat larger piece on the left side. The two halves of the medulla oblongata, pons Varolii, and cerebellum are separately movable, and on the cut surface of the last may be seen the arbor vitæ. The various structures on the base of the brain and the roots of the spinal nerves are shown.

204. Model of the brain, natural size, showing the basal surface.*From the Pedagogical Museum, St. Petersburg.*

E. 665.—1877.

The medulla oblongata, pons Varolii, pituitary body, and the origins of the cranial nerves are shown.

205. Model of the brain, natural size, in vertical section.*From the Pedagogical Museum, St. Petersburg.*

E. 664.—1877.

The corpus callosum, lateral ventricle with the optic thalamus, the pineal body, cerebellum, and pons Varolii are shown.

206. Model of the spinal cord and cerebellum, natural size.*Made by Montaudon (late Dr. Auzoux), Paris.*

E. 11.—1881.

The origins of the dorsal and ventral nerve-roots and their union to form the nerve-trunk are shown, as well as the brachial, lumbar, and sacral plexuses.

207. Model of the spinal cord and cerebellum.*From the Pedagogical Museum, St. Petersburg.*

E. 666.—1877.

Somewhat similar to No. 206 but showing less detail.

208. Two models of the human trunk, slightly reduced.

E. 7 and 8.—1879. *Made by T. P. Malling, Christiania.*

The anterior wall of the body lifts off to exhibit the thoracic and abdominal viscera. In the neck are seen the larynx, thyroid body, and the carotid arteries and jugular veins. Below these are the trachea, vena cava superior, the arch of the aorta with the innominate, left carotid and left subclavian arteries springing from it, the pneumogastric nerve crosses it, and in its concavity is the pulmonary artery. The pleuræ and the pericardium have been opened to exhibit the heart with the roots of the great vessels and the lungs. The heart and part of the lungs can be removed *en masse* so as to show the œsophagus, bifurcation of the trachea, bronchi, vena azygos major, part of the vertebral column, thoracic duct, descending aorta along with a magnified diagrammatic representation of the histological structure of the lung.

Lower down appear the front edge of the diaphragm, liver, gall bladder, stomach, spleen, colon or large intestine with appendix vermiformis, small intestine, with piece of mesentery and bladder. A block containing the front of the diaphragm, part of the liver, the stomach, and part of the spleen, is movable in order to show the vena cava inferior, abdominal aorta, section of the liver with its vessels (hepatic artery and vein and portal vein), part of the pancreas, the two kidneys, and suprarenal bodies. The left kidney has had the front removed to show the interior of its pelvis. The block itself exhibits the œsophageal opening of the stomach, the duodenum, into which an opening has been made to show the apertures of the biliary and pancreatic ducts; the pancreatic duct has been exposed for the latter part of its course. Part of the front wall shows the round ligament and other structures entering the umbilicus as well as the spermatic cord entering the inguinal canal.

209. Model of the human thorax and abdomen with the contained viscera, natural size.

From the Pedagogical Museum, St. Petersburg.

E. 662.—1877.

The anterior wall may be removed, showing, above, the larynx and thyroid body; below, the cavities of the pericardium and pleuræ, with the heart, great vessels and lungs *in situ*. Still lower is the edge of the diaphragm, and immediately under it the liver, part of the stomach, and large and small intestines. Part of the lungs and heart may be removed showing the descending aorta and the vena azygos. Part of the liver and the stomach can be taken out to show the form of the latter and its openings, as well as the descending aorta, vena cava inferior and left kidney.

210. Model of the human thoracic organs, natural size, mounted on a board. Made by Rammé and Sodtmann, Hamburg.

Exhibited by G. Gill & Co., 1878. Price 2l. 10s.

The thorax has been opened in front and in the neck, the larynx, trachea, thyroid body, carotid arteries and jugular veins are shown. The anterior portions of the lungs are movable as in the model just described. The front ventricular wall of the heart lifts off to show the cavities of the ventricles and their valves, whilst by similarly removing the wall of the auricles the roots of the pulmonary artery and aorta are exposed with their valves. On lifting out the heart as a whole there may be seen the bifurcation of the trachea, the descending aorta, the œsophagus and vena cava inferior.

211. Model of the human thorax, natural size.

Exhibited by R. M. Cameron and Son. 1879.

Price 3l. 3s.

The anterior wall has been removed showing the cut ends of the ribs. Above in the middle line are the larynx, thyroid body, and trachea, and on either side the innominate artery dividing into right subclavian and right common carotid, and the left common carotid and left subclavian arteries. The front of the lung can be removed on each side to show the ramifications of the pulmonary vessels and bronchi. The front of the wall of the heart can be lifted off in two pieces to show the cavities of the ventricles and auricles, and the whole organ lifts out of its place exhibiting the bifurcation of the trachea, the aorta, œsophagus, and vena cava inferior. Below is the diaphragm.

212. Model of the human thoracic viscera, natural size, mounted on a board.

From the Pedagogical Museum, St. Petersburg.

E. 667.—1877.

The thorax has been laid open in front, the larynx and thyroid body projecting above. The anterior halves of the lungs can be removed to show the pulmonary vessels and bronchi. The anterior wall of the heart can be taken off showing all its cavities and the root of the pulmonary artery with its valves. The remainder of the heart may be removed to show the bifurcation of the trachea, the descending aorta, and œsophagus. Two small separate models on the same stand exhibit enlarged vesicles from the lungs.

213. Model to illustrate the action of the intercostal muscles in respiration.

E. 158.—1874.

This consists of an upright rod on a stand; three other rods form with it a parallelogram, across the two diagonals of which are stretched elastic bands to represent the internal and external intercostal muscles.

214. Model of the heart and great vessels of the human foetus, with the principal cardiac nerves much enlarged.

E. 14.—1862. *Made by the late Dr. Auzoux, Paris.*

The left side of the heart can be removed *en masse* to exhibit the foramen ovale, whilst its own interior is shown by means of a movable flap. A door opens in the right auricle and ventricle exhibiting the Eustachian valve, which is also visible through a foramen in the posterior wall.

215. Model of the adult human heart, natural size.

E. 18.—1862. *Made by the late Dr. Auzoux, Paris.*

This is made to open in the same way as the foetal heart just mentioned, so as to show the differences in its internal anatomy.

216. Model of the human heart, with the roots of the great vessels, enlarged.

E. 6.—1879. *Made by T. P. Malling, Christiania.*

The pericardium has been reflected, and the front wall of the heart can be lifted off so as to show the interior of the auricles and ventricles, as well as of the root of the pulmonary artery with its valves.

217. Model of the human heart, much enlarged, mounted on a stand, in which is a drawer containing an explanatory pamphlet in German.

Exhibited by Paul Zeiller, Munich. 1879. Price 3l. 10s.

A door in the right side of the heart shows the tricuspid valve and the cavities of the right auricle and ventricle; the two halves of the heart are separable, and a door in the left side shows in addition the root of the aorta and its valves.

218. Model of the human heart, somewhat enlarged.

Made by Rammé and Sodtman, Hamburg.

E. 42.—1880.

The front wall of the right auricle can be lifted off to show the interior of that cavity, as also the front wall of the left

auricle, pulmonary artery, and aorta, to show the valves in their interior. The front ventricular wall can be removed to show the cavities of the ventricles and the auriculo-ventricular valves.

219. Model of the human heart, similar to No. 218, and constructed by the same makers.

Exhibited by G. Gill & Co. 1878. Price 22s. 6d.

220. Model of the human heart, much enlarged, mounted on a board.

Exhibited by R. M. Cameron & Son. 1879.

Price 2l. 2s.

The anterior wall lifts off to show the interior of the four cavities with their valves and the root of the pulmonary artery with its valves.

221. Model of the human heart, enlarged.

From the Pedagogical Museum, St. Petersburg.
E. 668.—1877.

Portions of the walls are movable, to show the various cavities with their valves.

222. Enlarged model of the human tongue, hyoid bone, and larynx.

E. 20.—1862. *Made by the late Dr. Auzoux, Paris.*

The first two can be separated from the last. The integument of the dorsum and of the right side of the tongue can be lifted off, as well as the glosso-pharyngeal muscle from the left side; here also the hyo-glossus muscles are separable. The left half of the body of the tongue can be taken off to exhibit the fan-like arrangement of the fibres of the genio-hyo-glossus muscle. The hyoid bone is thus left exposed on one side with its greater and lesser cornua. On the right side the submaxillary salivary gland and the submaxillary ganglion, as well as the sublingual salivary gland, are left.

A hook attached to the thyro-hyoid ligament in front allows the larynx to be removed from the tongue and hyoid, and the thyro-hyoid muscles on either side are also movable. The crico-thyroid muscles lift out on each side, and then by undoing a hook attached to the crico-thyroid ligament anteriorly and turning back the hinged right half of the thyroid cartilage, the whole of this latter can be removed. A small portion of the middle of it, however, is represented as being left attached to the crico-thyroid ligament in front so as to maintain the connexions of the muscles and vocal cords. A hook on the back liberates the trachea from the cricoid cartilage. The lateral and posterior crico arytenoid muscles are movable, and then a

hook attached to the cricoid cartilage in the middle line anteriorly admits of its separation. On the left side the thyro-arytenoid muscle and the arytenoid muscles are separable to show the arytenoid cartilage and the true vocal cord. On the right side the true and false vocal cords, and the pouch opening between them, are visible, and higher up the epiglottis and the opening into the larynx.

223. Model of the human larynx, somewhat enlarged. Made by Rammé and Sodtmann, Hamburg.

Exhibited by G. Gill & Co. 1878. Price 12s. 6d.

The model is not designed to show minute details; the organ is represented as bisected down the middle line to show its internal arrangements.

224. Model to illustrate the action of the muscles of the larynx.

E. 157.—1874.

This consists of an upright bar on a stand, to which another rod is hinged near its bottom. The upper ends of the two rods are connected by an elastic band, which represents the thyro-arytenoid muscle, whilst a second elastic band passes from the free end of the movable rod to the wooden stand.

225. Models of the human hip and shoulder joints, mounted on a board.

From the Pedagogical Museum, St. Petersburg.

E. 678 and 679.—1877.

The capsular ligaments have been divided to show the heads of the femur and humerus respectively with the cavity of the joint. In the case of the hip joint the round ligament is represented as divided.

226. Professor Cunningham's sectional models of the fully flexed elbow joint, in three parts.

E. 20.—1890.

Made by L. Casciani & Son.

227. Model of the human hand, enlarged.

E. 16.—1862.

Made by the late Dr. Auzoux, Paris.

The various muscles are made movable so that they can be successively removed in layers, to exhibit those which lie beneath them and the bones.

228. Model of the bones of the human hand, natural size, mounted on a stand.

E. 2.—1879.

Made by P. T. Malling, Christiania.

229. Model of the human foot, natural size.

From the Pedagogical Museum, St. Petersburg.
E. 675.—1877.

The integument has been removed to show the bones and ligaments, and the lower part of the gastrocnemius muscle has been left.

230. Model of the bones of the human foot, natural size, mounted on a stand.

E. 1.—1879.

By P. T. Malling, Christiania.

231. An enlarged model of the human eye, represented in an inverted position in a part of its orbit; the muscles and nerves have their names attached to them; for convenience the corresponding English terms are subjoined.

Made by Montaudon (late Dr. Auzoux), Paris.

E. 10.—1881.

The external rectus muscle can be removed to show the nerves which pass into the orbit between its two heads of origin. By undoing a hook on the inner side of the sclerotic coat the anterior part of this, along with the cornea, swings upon a hinge revealing the choroid, which can be removed, drawing out the optic nerve along with it. This with the nerve can be taken out of the choroid, and the crystalline lens removed from a depression in its anterior surface. Upon the vitreous body is the retina, and an attempt has been made to show the various layers of which this is composed.

List of Terms.

Droit externe.	External rectus muscle.
„ inférieure.	Inferior „ „
„ interne.	Internal „ „
„ supérieure.	Superior „ „
Petit oblique.	Inferior oblique muscle.
Grand oblique.	Superior „ „
Releveur de la paupière supérieure.	Elevator of the upper eyelid.
Paroi supérieure de la cavité orbitaire.	Upper wall of the orbit.
Nerf moteur commun.	Oculo-motor nerve.
N. lacrymal.	Lachrymal nerve.
Muscle sourcilier.	Supraciliary muscle.

232. Model of the human eye and eyelids, enlarged.

Exhibited by P. Zeiller, Munich. 1879. Price 3l. 10s.

The upper eyelid lifts off, and shows on its under surface the lachrymal gland with its ducts. On the eyeball are the stumps of the muscles. On lifting up the top half of the sclerotic the choroid with its vessels is exposed, and this in its turn reveals the vitreous body and the lens; the iris is removable from its groove in the anterior part of the sclerotic. To the inner side of the eyeball are the caruncle, the lachrymal ducts, and the expanded upper end of the nasal duct.

The whole is mounted on a wooden stand, with descriptive text in a drawer.

233. An enlarged model of the human eye dissected and lying in its orbit.

From the Pedagogical Museum, St. Petersburg.
E. 674.—1877.

As the model lies in the case it is inverted, the lower half of the wall having been removed. The long walls of the sides, back, and roof of the orbit are shown, and in front the palpebral muscle can be removed. The retina, optic nerve, lens, and choroid coat can be lifted out from the sclerotic, to which the internal, external, and superior rectus muscles are seen to be attached.

234. Enlarged model of the human eye-ball. Made by Rammé and Soldtmann, Hamburg.

Exhibited by G. Gill & Co. 1878. Price 28s. 9d.

The sclerotic to which the stumps of the muscles are attached can be lifted off, exposing the choroid and iris. The upper half of this with the included vitreous body can be removed, leaving the lens and the lower half of the vitreous.

On the back of the vitreous body an attempt has been made to show the layers of the retina.

235. Model of the human eye in its orbit, enlarged.

Made by Rammé and Soldtmann, Hamburg.
E. 40.—1880.

The eyelids can be taken off the centre of the stand; the upper part of the eyeball can be lifted off, and then the iris and choroid coats separated. The retina is painted on the outer surface of a glass representation of the vitreous body, to the front of which the lens is cemented.

236. Model designed by Helmholtz to illustrate the action of the muscles of the eye.

E. 155.—1874.

Made by H. Sittel, Heidelberg.

Two spheres, painted to represent enlarged eyeballs, are pivoted at their centres and mounted on a stand side by side. Strings are attached to them in the positions of the various muscles, and carried over appropriate pulleys, so that by traction upon them all the motions of the eyeballs can be imitated.

237. An enlarged model of the human ear, the different parts of which can be removed to show their form and arrangement.

Made by Montaudon (late Dr. Auzoux), Paris.

E. 9.—1881.

The different parts of the concha are named, and the vessels and nerves supplying them are shown. The concha as a whole can be removed. The upper part of the petrous portion of the temporal bone can be lifted off so as to expose the cavities of the middle and inner ears. The membrana tympani with its three ossicles attached can be taken from its place, as also that part of the facial nerve which lies within the petrous bone. The bony labyrinth can be taken as a whole from its place to be subsequently separated into three parts to exhibit its internal connexions. The cochlea is bisected down the middle to show its internal canals, and parts of the bony wall of the semicircular canals have been cut away to show the membranous labyrinth within. The blood vessels and nerves are very accurately shown throughout.

238. An enlarged model of the human ear, with the principal parts dissected out.

Exhibited by R. M. Cameron and Son. 1879.

Price 2l. 2s.

The membrana tympani can be seen down the external auditory meatus; it may be removed with the malleus and incus attached to it. The stapes is seen inserted in the foramen rotundum.

The bony labyrinth can be taken out from the petrous portion of the temporal bone, and a part of its wall may be removed to exhibit the membranous labyrinth within and the lamina spiralis of the cochlea.

239. An enlarged model of the human ear, with the principal parts dissected out. Mounted on a square black wood stand, with pamphlet of instructions in drawer at base.

Exhibited by P. Zeiller, Munich. 1879. Price 3l. 10s.

The different parts of the concha of the ear are numbered; the external auditory meatus has been opened throughout its length, showing the tympanic membrane at its end. The middle ear with the three ossicles has been opened from above, whilst the three semicircular canals and the cochlea have been dissected out from the petrous portion of the temporal bone.

240. An enlarged model of the human ear, dissected to show its principal parts.

From the Pedagogical Museum, St. Petersburg.

E. 673.—1877.

The concha of the ear can be removed from the wall of the skull, as also the membrana tympani with the attached ossicles from the middle ear. The three semicircular canals, one of which has been opened to show the membranous canal within it, and the cochlea, the lamina spiralis of which is exposed, can be separately taken out of their places in the petrous portion of the temporal bone.

241. Model to illustrate the action of the membrana tympani and the auditory ossicles.

E. 13.—1881.

Made by H. Sittel, Heidelberg.

The membrana tympani is represented by a piece of leather stretched over a circular hole in a vertical board, models of the ossicles are in relation with it, and their axes of rotation are fixed by tight strings. The stapes fits into an oval hole in a parallel board, and there is a long lever which indicates and magnifies its movements. On the back is a drum with caoutchouc sides by which pressure can be made upon the membrana tympani.

242. Model of a human molar tooth, enlarged.

From the Pedagogical Museum, St. Petersburg.

E. 677.—1877.

The model can be separated into two halves so as to show the dentine, enamel, pulp, and the vessels and nerves.

ii. *Comparative Anatomy and Systematic Zoology.*

243. Professor Cunningham's models illustrative of cranio-cerebral topography and brain growth.

E. 19.—1890.

Made by L. Casciani & Son.

Head of a seven months' fœtus.

Head of a newly born male child.

Head of a boy, 12½ years old

Head of adult male, 25 years old.

Head of elderly female, insane.

Head of man, 75 years old.

Head of man, 106 years old. (Born 31st January 1783, died 18th April 1889.)

Head of chimpanzee.

Head of orang-outan.

Head of chacma baboon.

244. Wax models of the brains of vertebrates, prepared at the Anatomical Institute of the Freiburg University under the direction of Prof. R. Wiedersheim.
E. 163.—1888. *Made by Dr. A. Ziegler, Freiburg-i.-B.*

Ammocetes branchialis.

Scyllium canicula.

Salmo fario.

Rana esculenta.

Alligator mississippiensis.

Columba domestica.

Lepus cuniculus.

Canis familiaris.

245. Models of the limbs of the male orang-outan (six years old).

E. 21.—1890.

Made by L. Casciani & Son.

a. Upper limbs. In one limb the hand is open, in the other it is represented grasping a piece of wood.

b. Lower limbs, in one piece.

246. Casts in fusible metal of the internal ears of the following species of Cetacea, to show the form and disposition of the semicircular canals.

Made and lent by Prof. Crum Brown. 1876.

Narwhal (*Monodon monoceras*).

Orcella fluminalis.

Orcella brevirostris.

Globiocephalus.

Platanista gangetica.

247. Set of wax models to illustrate the development of the trout (*Salmo fario*).

Made by Dr. A. Ziegler, Freiburg-i.-B.

E. 249 to 251.—1877.

There are 21 preparations, seven representing sections, which depict the principal phenomena in the early stages of the development of the common trout. The models are all made to a uniformly enlarged scale of 30 diameters; most of them can be seen by transmitted as well as by reflected light.

248. Enlarged model of the silkworm, constructed to take to pieces to show its anatomy.

E. 5.—1873. *Made by the late Dr. Auzoux, Paris.*

The model is separable into the following sections, each of which has its component parts numbered in correspondence with a descriptive pamphlet in French.

1. Dorsal portion of the body wall showing the integument and muscles.

2. Digestive apparatus.

3. Vessels and muscles of the head.

4, 5. Silk-spinning organ on the right and left sides.

6. Anterior portion of the nervous system.

7–11. Straight superficial central muscles of the various segments.

12. Inferior portions of the body with the buccal organs.

13. Left-hand segment of the lower portion of the body.

249. Enlarged model of a piece of honeycomb, with the different kinds of bees upon it. Most of these are constructed so that they may be taken to pieces to exhibit their anatomy.

E. 6.—1873. *Made by the late Dr. Auzoux, Paris.*

A. *The Queen Bee.* The upper wall of the abdomen may be removed, showing the heart, tracheæ, and digestive canal, which in its turn may be taken out and its different parts examined. The structure of the sting and of the generative organs is also exhibited.

B. *The Worker Bee.* The upper wall of the abdomen is similarly movable, showing the different arrangement of the organs from those in the last form.

C. *The Worker Bee* carrying a mass of wax under the abdomen

D. *The Worker Bee* bearing a load of pollen.

E. *The Nursing Worker Bee* laden with propolis.

F. *The Drone.* The upper part of the abdominal wall can be lifted off to show the digestive canal and the male generative organs.

G. *The Comb*, showing:—1, the royal cell; 2, cell filled with honey; 3, cell with embryonic male; 4, cell with embryonic worker; 5, empty cells; 6, eggs not hatched, less than three days old; 7, young larvæ; 8, soft pulp for feeding the larvæ; 9, cells opened to show the pupa enveloped in its protective coat; 10, protective coat opened; 11, bee issuing from the cell; 12, cell filled with pollen.

250. Models in plaster and glass of invertebrate animals which either because of their fugitive colours, delicacy

of consistence, or sensitiveness to re-agents cannot be adequately preserved for collections.

Made by *L. Blaschka, Dresden.*

E. 757 to 1148-1877 and E. 104 to 141-1888.

The following forms are exhibited:—

CHORDATA.

Tunicata.

- Boltenia clavata*, Stimps.
- " *Burkhardtii*, Agass.
- " *microcosmus*, Agass.
- " *rubra*, Stimps.
- Cynthia rustica* (L.).
- " *echinata*, Stimps.
- " *pyriformis*, Rathke.
- Corella parallelogramma* (Müll.).
- Ascidia clavigera*, Otto.
- " *callosa*, Stimps.
- " *aspersa*, Müll.
- " *ocellata*, Agass.
- " *patula*, Müll.
- " *hyalina*, Johnst.
- Clavelina lepadiformis*, Müll.

Salpa.

- Salpa pinnata*, Forsk.
- " *cærulescens*, Cham.
- " *dubia*, Cham.
- " *ferruginea*, Cham.
- " *vaginata*, Cham.
- " *bicornis*, Cham.
- " *zonaria*, Cham.
- Doliolum mediterraneum*, Otto.

MOLLUSCA.

Cephalopoda.

- Cirrotheuthis Mülleri*, Eschr.
- Argonauta argo*, L.
- Ocythoe tuberculata*, Raf., ♂ (= *Octopus carena*).
- " " ♀ (= *O. catenulatus*).
- Tremoctopus violaceus*, d. Ch. (also as *T. velifer*).
- Octopus vulgaris*, Lmk.
- " *tuberculatus*, Blv.
- " *Salutii*, Vér.
- " *De-Filippi*, Vér.
- " *macropus*, Risso
- " *Alderi*, Vér.
- " *Köllikeri*, Vér.

- Scæurgus unicirrhus* (d. Ch.) (= *O. cocco*).
Pteroctopus tetracirrhus (d. Ch.) and var.
Eledone moschata (Lmk.).
 " *cirrosa* (Lmk.) (= *E. Aldrovandi* and *E. Genei*).
Sepiola Rondeleti, Leach.
Rossia macrosoma, d. Ch.
Heteroteuthis dispar (Rüpp.).
Sepia officinalis, L.
 " *elegans*, d'Orb.
 " *Ruppellaria*, d'Orb.
Loligo vulgaris, Lmk.
 " *Bertheloti*, Vér.
 " *marmoræ*, Vér.
Thysanoteuthis elegans, Trosch. (= *Sepioteuthis sicula*).
Todarodes sagittatus (Lmk.) (= *Loligo todarus*).
Illex Coindeti (Vér.) (also as *Loligo sagittata*).
Ommastrephes æquipoda (Vér.).
 " *Alessandrini* (Vér.).
 " *Bianconii* (Vér.).
 " *Meneghini* (Vér.).
 " *Pillæ* (Vér.).
Abralia Oweni (Vér.).
 " *Véranyi* (Rüpp.).
Ancistroteuthis Lichtensteinii (Fér.).
Teleoteuthis Krohnii (Vér.).
Cheiroteuthis Véranyi (Fér.).
Doratopsis vermicularis (Rüpp.).
Histioteuthis Bonelliana (Fér.).
 " *Rüppelli*, Vér.
Loligopsis zygæna, Vér.

Pteropoda.

- Clione limacina* (Phipps) (= *Clio borealis*).
Cavolinia crassicornis, Esch.
 " *subrosea*, Esch.

Gastropoda.

- Parmacella Valenciennesi*, Webb & v. Ben.
Limax agrestis, L.
 " *albus* var. *flavomarginatus*, Fér.
 " *alpinus*, Fér.
 " *campestris*, Binney.
 " *corsicus*, Moq.-Tand.
 " *gagates*, Fér.
 " *marginatus* var. *rufilus*, Drap.
 " *maximus*, L.
 " *variegatus*, L.
Arion ater, L.
 " *marginatus*, Fér.
 " *empiricorum*, Fér.
Helix arbustorum, Ll.
 " *vindobonensis*, Pfr. (= *H. austriaca*).

- Helix hortensis*, L.
 „ *incarnata*, Müll.
 „ *lapicida*, L.
 „ *nemoralis*, L.
 „ *pomatia*, L.
Bulimina montana (Drap.).
 „ *detrita* (Müll.).
Clausilia laminata (Mont.) (= *C. bidens*, Drap.).
 „ *biplicata* (Mont.) (= *C. similis*, Charp.).
Succinea putris, L.
 „ *Pfeifferi*, Rossm.
Limnæus auricularis (L.).
 „ *stagnalis* (L.).
 „ *palustris*, Drap.
Planorbis corneus (L.).
Paludina vivipara (L.) (= *P. achatina*).
Cyclostoma elegans (Müll.).
Archidoris flammea (Ald. & Hanc.).
Doris coronata, Agass.
 „ *diademata*, Agass.
 „ *bilamellata*, L.
 „ *nigricans*, Otto.
 „ *grisea*, Stimps.
 „ *pallida*, Agass.
 „ *planulata*, Stimps.
 „ *tenella*, Agass.
 „ *fusca*, Müll.
 „ *pilosa*, Müll.
Ancula sulphurea, Stimps.
Polycera lessoni, d'Orb.
Pleurophyllidea lineata (Otto).
Dendronotus arborescens, Müll.
Limanotus marmorata (Ald. & Hanc.).
Embletonia remigata, Gould.
 „ *fuscata*, Gould.
Æolis Bostonensis, Couth.
 „ *coronata*, Johnst.
 „ *despecta*, Johnst., and var.
 „ *gymnonota*, Couth.
 „ *papillosa*, Ald. & Hanc.
 „ *farinacea*, Gld. & Binn.
 „ *salmonacea*, Gould.
 „ *diversa*, Gld. & Couth.
 „ *pileata*, Gld. & Binn.
 „ *stellata*, Stimps.
 „ *rufibranchialis*, Alder.
 „ *picta*, Ald. & Hanc.
Æolidia annulicornis, Eysh.
 „ *pinnata*, Esch.
 „ *hystrix*, Otto.

- Glaucus atlanticus*, Forst.
 „ *pacificus*, Esch.
Doto coronata, Gm.
Alderia hawardiensis (Agass.).
Elysia chlorotica, Gld. & Binn.
Phenicurus tethydicola, Otto.

CRUSTACEA.

Lernæacea.

- Anops gobina*, Müll.
 „ *radiata*, Müll.
Penella diodonta, Oken.

VERMES.

Chaetopoda.

- Tubifex marinus*, Lmk.
 „ *sabellaris*, Lmk.
Sternaspis thalassemoides, Otto.
Trophonia Mülleri, Oken.
Lanice conchilega, L.
Terebella cristata, L.
 „ *Emmalina*, Quatref.
Sabella penicillus, L.
Serpula contortuplicata, L.
 „ *vermicularis*, L.
Eunice pinnata, L.
Autolytus cornutus.

Hirudinea.

- Hirudo vittata*, Eysenh.
Malacobdella grossa, L.

Gephyrea.

- Priapulus caudatus*, Lmk.

Turbellaria.

- Planaria lactea*, Müll.
 „ *nigra*, Müll.
 „ *viridis*, Müll.
 „ *rutilans*, Müll.
 „ *radiata*, Müll.
 „ *tetragona*, Müll.
 „ *marmorea*, Müll.
 „ *truncata*, Müll.
 „ *grossa*, Müll.
 „ *rostrata*, Müll.
 „ *lingua*, Müll.
 „ *strigata*, Müll.
 „ *rubra*, Müll.
 „ *operculata*, Müll.

- Planaria subulata*, Müll.
 „ *caudata*, Müll.
 „ *auriculata*, Müll.
 „ *filaris*, Müll.
 „ *cornuta*, Müll.
 „ *atomata*, Müll.
 „ *rosea*, Müll.
 „ *flaccida*, Müll.
 „ *gesnerensis*, Müll.
Mesostomum variabile, Oerst. (= *Planaria fulva*, *P. viridata*,
 and *P. grisea*, O. F. Müll; and *Typhloplana viridata*,
 Oerst.).
Mesostomum rostratum.
Vortex viridis, M. Sch. (= *Planaria belluo*, O. F. Müll).
Schizostomum productum, O.S.
Centrostromum polycyclium (Schmarda).
Dendrocelum lacteum, Oerst.
Eurylepta undulata (Kelaart).
Yungia rubrocincta (Schmarda).
 „ *miniata* (Schmarda).
Leptoplana gigas.
 „ *lanceolata*, Schmarda.
 „ *purpurea*, Schmarda.
 „ *otophora*, Schmarda.
 „ *tremellaris*, O. F. Müll.
Proceros clavicornis.
 „ *latissimus*.
 „ *viridis*.
Stylochus oxyceraeus.
Planocera dictyotus (Schmarda).
Thysanozoon discordeum.
Polycelis microsoma.
Stylostomum variabile, Lang.
Prostomum lineare, Oerst.
Cryptocelis compacta, Lang.

ECHINODERMATA.

Holothurioidea.

- Synapta maculata* (Cham. & Eys.).
 „ *mamillosa*, Esch.
 „ *fasciata*, Kuhl & v. Hass.
 „ *inhærens* (O. F. Müll.).
 „ *verrucosa* (Esch.).
 „ *lumbricoides* (Esch.).
 „ *oceanica* (Less.).
Chirodota discolor, Esch.
Trochostoma ooliticum (Pourt.).
Cucumaria crocea (Less.).

- Colochirus quadrangularis* (Less.).
Psolus phantapus (Strussenf.).
Thyone fusus (O. F. Müll.).
 " *peruana* (Less.).
Holothuria tremula, Gunner.
 " *radackensis*, Cham. & Eys.
 " *monocaria* (Less.).
 " *edulis*, Less.
 " *impatiens* (Forsk.).
 " *tubulosa*, Gm.
 " *maculata* (Kuhl & v. Hass.).

Ophiuroidea.

- Ophiolepis annulosa* (Blainv.).
Ophioplocus imbricatus (Müll. & Tr.).
Ophiopholis aculeata (L.).
Ophiocoma nigra (Abildg.).
Ophiarachna incrassata (Lamk.).
Ophiarthrium pictum (Müll. & Tr.).
Ophiomastix annulosa (Lamk.).
Ophiothrix longipeda (Lamk.).
 " *fragilis* (Abildg.).
 " *serrata* (Kuhl & v. Hass.), Herkl.
Euryale novæ guineæ (Müll.).

Asteroidea.

- Porania pulvillus* (O. F. Müll.).
Astropecten bispinosus (Otto).
 " *angulosa* (Lamk.).
 " *violacea* (Lamk.).
Goniodiscus Sebæ, Müll. & Tr.
Pentaceros muricatus, Linck.
Gymnasteria carinifera (Lamk.).
Nardoa tuberculata, Gray.

Crinoidea.

- Actinometra solaris* (Lmk.).

CŒLEENTERATA.

Hydrozoa.

- Sarsia siphonophora*.
Tima flavilabris.
Stephanomia canariensis.
Physalia pelagica, Bosc.
Physophora hydrostatica, Forsk.
Ægina citrea, Esch.
 " *rosea*, Esch.
Æquorea cyanea, Péron & Lesueur.
 " *Forbesiana*, Gosse.
 " *Forskalea*, Pér. Eschsch.
 " *vitrina*, Gosse.

- Aurelia aurita*, (L.) Péron.
 „ *crenata*, Cham.
 „ *globularis*, Cham.
Berenice Euchroma, Pér. Les.
 „ *rosea*, Péron.
Beroë elliptica, Eschsch.
 „ *ovata*, Bosc.
 „ *pileus* (Gmelin) Müll.
 „ *punctata*, Cham.
Carmarina hastata, Haeckel ♂.
 „ „ „ ♀.
Cassiopea frondosa, Pallas.
Charybdea periphyllum, Péron.
Chrysaora cyclonata, Péron.
Cunina campanulata, Esch.
Cyanea Labichii, Quoy & Gaim.
Dianœa Gaberti, Quoy & Gaim.
Eudora undulosa, Péron.
Eucharis Tiedemanni, Esch.
Eulimena cyclophylla, Pér. & Les.
Favonia octonema, Péron.
Geryonia tetraphylla, Cham.
Glossocodon eurybia, Haeckel.
Hippopoda lutea, Quoy & Gaim.
Lymnorea triedra, Péron & Les.
Medea constricta, Cham. & Eys.
Melicertum Perla, Péron, Cuv.
Melitea brachyura, Lesson.
Obelia sphærulina, Péron.
Orythia viridis, Pér. & Les.
Pelagia panopyra, Pér. & Les.
Physalia arethusa, Lamk.
 „ *megalista*, Pér.
Phorecynia Eudonoidea, Péron.
Physophora myzonema, Péron.
Porpita gigantea, Péron.
Rhizostoma Cuvierii, Péron.
 „ *leptopus*, Cham.
Rhizophysa Chamissonis, Eys.
 „ *heliantha*, Quoy & Gaim.
 „ *filiformis*, Péron & Les.
Stephanomia uvaria, Lesueur.
Velella lata, Cham. & Eysh.
 „ *oblonga*, Cham. & Eysh.
 „ *sinistra*, Cham. & Eysh.

Anthozoa.

- Edwardsia microps* (Gosse).
 „ *Beautempsii*, Quatref.
Edwardsiella carnea (Gosse).
Halcampa chrysanthellum (Peach).

- Siphonactinia triphylla* (Gosse).
 " *undata* (Gosse).
 " *hastata* (Gosse).
Octophellia gausapata (Gosse)
Phellia murocincta, Gosse.
Phellia Brodricii, Gosse.
Chitonactis coronata (Gosse).
Actinoloba dianthus (Ellis)
Heliactis bellis (Ellis).
 " *miniata* (Gosse).
 " *venusta* (Gosse).
Cylista viduata (Müller).
 " *undata* (Müller).
 " *coccinea* (Müller).
Adamsia Rondeleti (D. Ch.).
 " *palliat*a (Bohadsch).
Aiptasia Couchi (Gosse).
 " *diaphana* (Rapp).
Sagartia sphyrodeta, Gosse.
 " *ichthyostoma*, Gosse.
Aiptasia nivea (Less.).
 " *pura* (Alder).
 " *pallida* (Holdsw.).
Actinia equina, L.
 " *Cari*, Ch.
Anemonia sulcata (Penn.).
 " *Contarini* (Heller).
Tealia crassicornis (Müller) and var.
Tealia digitata (Müller).
Bolocera Tuediæ (Johnst.).
 " *eques*, Gosse.
Bunodes gemmaceus (Ellis) and var.
 " *Balli* (Cocks).
 " *thallia*, Gosse.
Cereactis aurantiaca (d. Ch.).
Hyanthus Mitchelli, Gosse.
 " *scoticus*, Forbes.
Paractis peruviana (Less.).
Corynactis viridis, Allman.
Capnea sanguinea, Forbes.
Aureliana teterocera (Thomps.)
Rhodactis rhodostana.
Ulactis muscora.
Palythoa arenacea (d. Ch.).
 " *sulcata* (Gosse).
Megalactis Hemprichii, Ehrbg.
Zoanthus Alderi, Gosse.
 " *Solanderi*, Less.
Cerianthus solitarius (Rapp).
 " *Lloydii*, Gosse.

Arachnaectis albida, Sars.
 Hormathia Margaritæ, Gosse.
 Stomphia Churchiæ, Gosse.
 Sagartia (?) chrysoplenius, Gosse.
 Gregoria fenestrata, Gosse.
 Euphyllia glabrescens (Cham. & Eys.).
 Caryophyllia Smithii, Stokes, and var.
 Lophohelia prolifera (L.).
 Lucernaria auricula, Müll.
 " quadricornis, Müll.
 Paracyathus pteropus, Gosse.
 " taxilianus, Gosse.
 " thulensis, Gosse.
 Phyllangia Americana, Gosse.
 Sphenotrochus Macandréanus, M. Edw.
 " Wrightii, Gosse.
 Alcyonium digitatum, L.
 " cydonium, L.
 Massarium massa, Müller.
 Pennatula grisea, L.
 " rubra, L.
 Renilla violacea, Q. & G.
 Umbellularia stellifera, L.
 Veretillum cynomorium, Pall.
 Virgularia mirabilis, Müll.
 Sympodium cœruleum.

F. DIAGRAMS AND PLANS.

251. Lecture diagrams. A set of 11 illustrating the anatomy of the human body. Designed by Prof. J. Marshall.

Exhibited by Smith, Elder, and Co. 1876. Price 21s. each.

Skeleton and ligaments.

Muscles, joints, and animal mechanics.

Viscera in position and structure of the lungs.

Heart and blood-vessels.

Lymphatics and absorbents.

Digestive organs.

Brain and nerves.

Organs of the senses, Plate I.

 " " Plate II.

Microscopic structure of the textures, Plate I.

 " " " Plate II.

252. Lecture diagrams illustrating the main facts of human anatomy.

Exhibited by W. and A. K. Johnston. 1888.

Price 12s. each.

Skeleton, joints, muscular and vascular systems.

Veins, organs of digestion, nervous system, organs of sense and voice.

253. Lecture diagrams. A set of three illustrating human anatomy.

Exhibited by T. Ruddiman Johnston. 1887.

Skeleton, muscular system, digestive organs.

Circulation and excretion.

Nervous system, organs of sense.

254. Lecture diagrams. Prepared for use in the Biological Laboratory, Royal College of Science, South Kensington. 1887.

The histology of the capillaries. A \times 5.

Transverse section of a vein and an artery. A \times 6.

The skeleton of the common frog (*Rana temporaria*). Jb. 23.

The edible frog (*Rana esculenta*) dissected so as to show the viscera. Jb. 15.

The edible frog (*Rana esculenta*) dissected so as to show the viscera from the side. Jb. 20.

The alimentary canal and the cavity of the mouth of the common frog (*Rana temporaria*). Jb. 14.

Phenomenon of coagulation of blood in capillary of web. Frog. Jb. 29.

The general arrangement of the circulatory apparatus in the amphibia. Jb. 28.

The arrangement of the respiratory organs in the dog-fish. Kb. 30.

The lung sacs of *Ceratodus*, *Protopterus*, and *Lepidosiren* (after Owen, Günther, and Wiedersheim). Ka. 7.

The respiratory organs of the cod-fish (*Gadus morrhua*). Kd. 58.

The respiratory organs of the lamprey (*Petromyzon*) and the hag-fish (*Myxine*). Ke. 6.

The crayfish (*Astacus fluviatilis*) dissected from the side and from above. Od. 53.

The crayfish (*Astacus fluviatilis*) dissected so as to show the gills. Od. 56.

The crayfish (*Astacus fluviatilis*) dissected from the side. Od. 58.

The fresh-water mussel (*Anodonta cygnea*) dissected so as to show the alimentary canal and nervous system. Ld. 25.

The anatomy of the human lung, after Aeby. Aa. 116.

The anatomy of the respiratory organs of the sloth (*Bradypus*). Ga. 29.

The anatomy of the air-sacs of the duck, after Stroner. Hc. 92.

The ventral air-sacs of the pigeon with the humerus. Hc. 93.

The sternum and trachea of the crane. Hc. 95.

The structure of the lung of the goose, after Stricker. Hc. 98.

The sternum and trachea of *Nothocrax* and *Phonygama*. Hc. 100.

The skeletons of the wolf and man placed side by side for comparison. Ca. 33.

The right pes (dorsal view) of the wolf and man. Ca. 34.

The right manus (dorsal view). Ca. 35.

The skull of the wolf and man superposed to show the different form of the corresponding parts. Ca. 36.

The bifurcation of the bronchi, Aeby. A. \times 2.

The alveoli of the lung of the ape and the cat. A. \times 3.

The histology of the lung. A. \times 4.

Larval oyster. Ld. 39.

The rabbit (*Lepus cuniculus*) dissected from the side. Bc. 33.

The intestinal epithelium of the frog and the rat, showing the process of absorption, after Schäfer. Bc. 38.

The general arrangement of the circulating organs in the rabbit. Bc. 42.

The anatomy of the lungs in the rabbit. Bc. 43.

A transverse section of the thorax in the rabbit. Bc. 44.

The anatomy of the lungs of the porcupine (*Hystrix*). Bc. 45.

The anatomy of the ear of the rabbit. Bc. 35.

The histology of the ear of the rabbit. Bc. 36.

The general arrangement of the circulatory organs in the fish. Kb. 33.

The fresh-water mussel (*Anodonta cygnea*) dissected so as to show the shell, the heart, and the muscles. Ld. 24.

The fresh-water polyp (*Hydra fusca* and *H. viridis*) showing the external characters, the genitalia and the thread cells. Nb. 25.

The fresh-water polyp (*Hydra sp.*) showing its minute structure. Nb. 26.

The fresh-water polyp (*Hydra sp.*) showing the cells of the inner layer or endoderm. Nb. 29.

The development of the fresh-water polyp, *Hydra sp.*, after Kleinenberg. Nb. 27.

Various forms of the proteus animalcule (*Amæba*), after Leidy. Qa. 2.

The proteus animalcule engaged in feeding and reproduction.
Qa. 3.

255. Lecture diagrams. A set of nine illustrating the principal groups of the animal kingdom. Designed by Drs. Leuckart and Nitsche.

Exhibited by Th. Fischer, Cassel. 1880. Price 3s. each.

Mollusca.

Coelenterata

Arthropoda (4).

Protozoa.

Echinodermata (2).

256. Lecture diagrams illustrating the principal types of the animal kingdom.

Exhibited by W. and A. K. Johnston. 1888. Price 12s. each.

Protozoa and Coelenterata.

Echinodermata, Scolecida, Annulosa.

Molluscoida and Mollusca

Vertebrata.

257. Patterson's Zoological Diagrams. Prepared for the Department of Science and Art. The drawings have been executed by Messrs. Wolf, Bailey, Ford, and Tuffen West. Size, 40½ in. by 29 in.

Published by Chapman and Hall. 1863.

258. Lecture diagrams. A set of 50, illustrating the differences between the various breeds of the horse and ox, as well as the principal features in the anatomy of these animals. Prepared by M. Wilckens.

Exhibited by Th. Fischer, Cassel. 1880. Price, horse, 40s. the set, ox, 36s. the set.

259. Diagram with illustrations of the most common insectivorous birds found in Victoria, to enable those interested to assist in their protection.

Designed and presented by Prof. F. McCoy. 1878.

260. Diagram with figures of the dangerous snakes of Victoria, to assist the public in recognising and avoiding or destroying them.

Designed and presented by Prof. F. McCoy. 1878.

261. Lecture diagrams. A set of two showing the anatomy and physiology of the honey-bee and its relations to flowering plants. Drawn by Frank R. Cheshire.

Exhibited by the British Bee Keepers' Association. 1880.

262. Photograph, framed, with plans of the zoological station at Naples.

Lent by A. G. Dew Smith. 1876.

263. Natural History diagrams for use in Austrian schools.

Price, unmounted, 1s. 3d. each.

Given by E. Pick. 1880.

III. BOTANY.

A. APPARATUS.

264. Germinating apparatus, designed by Prof. F. Cohn, Breslau, for the simultaneous germination of a large number of seeds, or for the cultivation of microscopical organisms at a constant degree of temperature and moisture.

From the Institute of Vegetable Physiology, University of Breslau.

E. 252.—1877.

This apparatus satisfactorily replaces the germinating apparatus of Nobbe. The seeds are soaked for 24 hours in water, then 200 are placed in each earthenware dish and covered over. The enclosed tin dishes are then filled with water, which keeps in the porous clay dishes the moisture requisite for the development of the seeds. The space between the double walls of the chamber is now filled three-quarters full with water (the height of the water can be seen by the glass gauge), and a small gas flame, governed by a Bunsen's regulator and placed underneath the germinating chamber, keeps the temperature very constant. This apparatus is used for the examination of the germinating power of agricultural seeds, which takes place at the laboratory for experiments on seeds ("Samen-Controll Station") connected with the Institute of Vegetable Physiology. Similar apparatus of different sizes are used in this station continually for the culture of plants, especially microscopical growths, at a constant temperature. They were employed especially by Prof. Cohn in his researches on Bacteria.

265. Incubator, designed by Prof. Babe, for the purpose of maintaining fungi or other organisms at a constant temperature.

E. 28.—1887.

The apparatus consists of a sheet-iron case with double walls and a glass door. The space between the walls is filled with

water to act as a non-conducting layer, and a covering of thick felt is placed over the door for a similar purpose. A glass gauge indicates the level of the water. The lower part of the water space is prolonged downwards into a pyramidal receptacle, which holds a considerable quantity of water to diminish the risk of rapid changes of temperature. It is heated by two gas burners with mica chimneys.

266. Auxanometer for recording the rate of growth of plants.

E. 254.—1877.

Made by E. Stöhrer, Leipzig.

A thread is attached to the growing tip of the plant and carried upwards over a pulley, the edge of which is provided with extremely fine teeth. A delicate spring rests against these teeth and is so arranged that as each one passes it an electric current is made and broken. In the same circuit is a writing point which marks upon a disc of paper rotated by clock-work. The result of this arrangement is that at every increment of about half a millimetre ($\frac{1}{50}$ inch) in the height of the plant a deviation from the circle is made by the writing point.

267. Auxanometer of more modern pattern.

Made by the Cambridge Scientific Instrument Co.

E. 33.—1887.

The growing shoot of the plant is attached to a lever which writes upon a revolving drum, the increment in the length of the plant being highly magnified. By an attached clock-work the drum can be made to rotate one tooth of a ratchet every $\frac{1}{4}$, $\frac{1}{2}$, or 1 hour, so that the increase in length of the plant during any time can be ascertained from the tracing on the drum.

268. Apparatus, devised by Prof. F. Cohn, Breslau, for demonstrating Knight's experiment on the influence of gravity on the direction of the growth of roots and stems of budding plants.

From the Institute of Vegetable Physiology, University of Breslau.

E. 253.—1877.

The apparatus consists of a hexagonal tin box with vertical sides, through the central points of which runs a horizontal axle supporting a small disc of cork and a waterwheel which serves to rotate it. A pipe passing through the cover of the box supplies the necessary water. The mode of using is as follows:—

Some seeds (by preference *Pisum sativum* and *Zea mays*) are soaked for 24 hours in water, and then attached by long needles, which must not pass through the radicle or the plumule, but

only through the cotyledons or the endosperm, radially to the circumference of a disc of cork. The apparatus is set in action by connecting the caoutchouc tube of the cover with the water supply or a water reservoir. By regulating the strength of the stream of water the rate of the waterwheel can be increased or diminished. The splashing of the water furnishes sufficient moisture for the germination of the seeds, so that all the roots are developed centrifugally, whilst the stems grow in a centripetal direction. The observations can be made through the glass window, which is, however, generally closed by a shutter in order to keep out the light.

269. Shade, devised by Prof. Sachs, for growing plants under the influence of coloured light.

Made by Warmbrunn, Quilitz, & Co., Berlin.

E. 173.—1877.

The apparatus consists of two glass shades placed one within the other and united at the bottom. The outer shade has an aperture at the top by which a coloured liquid can be introduced into the space between the two glasses.

270. A smaller shade similar to No. 269.

Made by Warmbrunn, Quilitz, & Co., Berlin.

E. 174.—1877.

271. Illustrations of the system of instruction pursued in the schools at Hitcham, Suffolk, under the superintendence of the late Professor Henslow.

Presented by the late Professor Henslow.

E. 97 to 100 and 101 a & b.—1857.

These consist of notes on the lessons, figures, various apparatus, with descriptions, schedules, and labels.

B. SPECIMENS.

272. Herbarium containing specimens of British plants growing wild, and a few common trees in plantations in the parish of Hitcham, Suffolk. These plants were collected and arranged by the pupils in the schools at Hitcham who had undergone Prof. Henslow's course of instruction as explained in his illustrations. See No. 271. In cabinet.

Presented by the late Professor Henslow.

E. 101.—1857.

273. A collection of botanical specimens prepared by the late Professor Henslow.

E. 4 to 12.—1869.

Given by W. J. Stewart.

274. Collection of specimens of the fruits of 128 different species of plants for the use of botanical students.

E. 96.—1857. *Prepared by the late Professor Henslow.*

Many are shown in longitudinal or transverse section, or have been opened in some other way to show their internal arrangements.

275. Sections of a hundred kinds of wood, embracing the forest and garden species, as well as the commonest forest shrubs of Germany. Prepared by Dr. H. Nördlinger. In two book boxes with introductions to the mode of classification.

E. 1.—1867. *Given by the late Sir C. W. Dilke, Bart.*

276. Specimens of twenty-four kinds of natural and artificial grasses and their seeds. In glass tubes, with stoppers to contain the seeds.

E. 9.—1883.

Given by Messrs. Sutton & Sons.

277. Case of specimens, illustrating the domination of one plant over another in the mixed herbage of grass land, under the influence of different manures, each applied year after year on the same plot.

Lent by Sir John Bennet Lawes, Bart. 1876.

The experiments were made in Mr. Lawes' park, at Rothamsted, near St. Albans, commencing in 1856, at which time the character of the herbage was apparently pretty uniform over all the plots, and there were 50 species or more growing together. There are about 20 experimental plots, from a quarter to half an acre each; two being left continuously without manure, and each of the others receiving its own special manure year after year. Under this varied treatment, changes in the *flora*, so to speak, became apparent even in the first years of the experiments; and three times since their commencement, at intervals of five years—namely, in 1862, 1867, and 1872—a carefully averaged sample of the produce of each plot has been taken and submitted to careful botanical separation, and the per-centage by weight of each species in the mixed herbage determined. Partial separations have also been made in other years. The specimens exhibited in the case show the botanical composition of the herbage on 12 selected plots, in the 17th season of the

experiments, 1872 ; and the quantities represent the relative proportion by weight in which each species was found in the mixed produce of the plots.

The mean produce of hay per acre per annum has ranged on the different plots from about 23 cwts. without manure, to about 64 cwts. on the plot most heavily manured.

The number of species found has generally been about 50 on the unmanured plots, and has been reduced to an average of only 20, and has sometimes been less, on the most heavily manured plots.

Species belonging to the order *Graminaceæ* have, on the average, contributed about 62 per cent. of the weight of the mixed herbage grown without manure, about 55 per cent. of that grown by purely mineral manures (that is, without nitrogen), and about 93 per cent. of that grown by the same mineral manures with a large quantity of ammoniacal salts in addition.

Species of the order *Leguminosæ* have, on the average, contributed about 8 per cent. of the produce without manure, about 26 per cent. of that with purely mineral manures, and less than 0.01 per cent. of that with the mixture of the mineral manures and a large quantity of ammoniacal salts.

Species belonging to various other orders have, on the average, contributed about 30 per cent. of the produce without manure, about 19 per cent. of that with purely mineral manures, and only about 7 per cent. of that with the mixture of the mineral manures and a large amount of ammoniacal salts.

Not only the amount of produce, but the number and description of species developed, have varied very greatly between the extremes here quoted, according to the particular character or combination of manure employed, as is strikingly illustrated by the arrangement of the specimens in the case.

278. Specimens of Barley grown in Sweden, with description, part of the collection of cereals arranged by J. Eriksson. In progress.

Published by Victor Petterson, Stockholm.

E. 58.—1889.

279. *Phykotheke Universalis*. A collection of examples of seaweeds. In progress.

By Dr. F. Hauck and Paul Richter, Leipsic.

E. 59.—1889.

280. A series of mounted preparations and drawings showing insects injurious to vegetation, damage caused by them, and methods of extermination. Prepared for the Science and Art Department by Miss E. Ormerod and Prof. J. O. Westwood.

Insects injurious to Pears.

1. *Tinea clerkella*: leaves eaten by.
 2. *Selandria æthiops*: perfect insects, and enlarged drawing; gnawed leaves and drawing of leaf with larvæ.
 3. *Argyromyges scitella*: perfect insects and enlarged drawing.
 4. *Psylla pyri*: perfect insects, enlarged drawing and injured leaves.
 5. *Typhlodromus pyri*: injured leaves (mite).
 6. *Astyages hemerobiella*: perfect insect, enlarged drawing, injured leaf and drawing of leaf with larva in its case.
 7. *Eriosoma lanigera*: swellings on roots due to.
 8. *Cecidomyia nigra*: model of young pear destroyed by larvæ feeding inside it.
 9. *Zeuzera æsculi*: perfect moth, with pieces of stems bored by the larvæ, which are shown in their burrows.
 10. *Lyda fasciata*: enlarged drawing of perfect insect, with nest of larvæ and drawing of ditto.
 11. *Tortrix Weberana*: perfect insect, enlarged drawing, and piece of stem with burrows of larvæ, and exuviae of chrysalids sticking out of them.
 12. *Anthonomus pyri*: young pears gnawed by the larvæ of.
 13. *Tortricidæ*: reared from rolled-up pear leaves.
 14. *Otiorhynchus vastator* (Weevil): pear bloom gnawed by.
 15. *Aspidiotus ostræformis*: (Oyster scale insect) drawing of twig with scales, of male and of females (enlarged).
 16. *Coccus* of pear tree.
- E. 129.—1886.

Insects injurious to Bush Fruits.

A. Currant.

- 1, 2. *Myzus ribis*: perfect insects, enlarged drawings of apterous and winged females, of winged male, and of pupa of male.
3. *Rhopalosiphum ribis*: enlarged drawings of apterous and winged females, and of leaf showing the red bladders under which the insects hide.
- 4-6. *Phytoptus ribis*: injured twigs; sketch of injured branch and of a magnified bud; enlarged drawing of mite.
- 7-10. *Sesia tipuliformis*: perfect insects, enlarged drawing, larva, and sketch of larva within a stem.
- 11-18. *Vanessa (Grapta) C.-album* (comma butterfly): perfect insect of spring brood, with drawing of upper surface and under side of wing; perfect insects of summer brood, showing upper and under surfaces, with drawings of the same; larvæ on models of leaves.

19. Specimen of *Pimpla flavonotata*, which is parasitic on the larvæ of *Vanessa C.-album*.

20, 21. *Deræocerus fulvomaculatus*: perfect insect and enlarged drawing.

B. Gooseberry and Currant.

22-31. *Nematus ribesii* (sawfly): perfect insects, with enlarged drawings: sketches of leaves, with larva, with eggs deposited along the ribs on the under surface, and showing the mode in which the leaf is eaten.

32-36. *Abraxas grossulariata* (magpie moth): perfect insects and drawing; larvæ on model of leaf; model of gnawed leaf.

37. *Ichneumon trilineatus*: } flies parasitic on the larvæ of
38. *Casinaria vidua*: } *Abraxas grossulariata*.

39-41. *Halia wavaria* (V-moth): perfect insects, with drawing; model of a leaf with larvæ.

C. Raspberry.

42-45. *Otiorhynchus sulcatus*: perfect insects, with enlarged drawings; larvæ and enlarged drawing.

46, 47. *Otiorhynchus picipes*: perfect insects and enlarged drawing.

48, 49. *Otiorhynchus tenebricosus*: perfect insects and enlarged drawing.

50, 51. *Byturus tomentosus*: perfect insects and enlarged drawing.

E. 135.—1886.

Insects injurious to Wheat and other Cereals.

1. *Aphides*: ears of wheat injured by.

2. *Coccinella septem-punctata*: perfect insect and pupa skin; the larva feeds upon Aphides.

3. *Oscinis lineata*: perfect insects; enlarged drawing of perfect insect, as well as of larva eating the stem of a young plant, and perfect insect on the leaf; young plants injured by the larvæ, one has thrown out a number of side shoots, the central stem having been destroyed; heads of barley, the interior of the stem of which has been injured by the larvæ and still contains the pupa-cases.

4. *Oscinis atricilla*: perfect insects, with enlarged drawing; also drawing of oat-flower with cocoon derived from larvæ, which has fed within the flower sheath.

5. *Elatér lineatus* (striped click-beetle): perfect insects and larvæ; drawings of insect, natural size and enlarged, larva enlarged and young plant attacked by it.

6. *Cecidomyia tritici* (wheat midge): perfect insect and enlarged drawing of it and of wheat-flower with larvæ feeding; injured ear of wheat.

7. *Thrips cerealium*: two enlarged drawings of insect, which sucks and injures wheat plants.

8. *Cephus pygmaeus*: enlarged drawing of insect and of larva, which feeds within the stem of the wheat plant.

9. *Tinea granella*: enlarged drawings of perfect insect and larva; specimen and enlarged drawing of grains of wheat fastened together with threads spun by the caterpillars and mixed with their excrement.

10. *Anobium paniceum*: pearl barley and macaroni, gnawed by the larva.

11. *Tribolium ferrugineum*: perfect insects and piece of ship's biscuit with burrows of larvæ.

12. *Calandra granaria* (corn weevil): perfect insects and grains of wheat, the interior of which has been gnawed out by the larvæ; enlarged drawings of perfect insect, larva, and gutted grain of wheat containing the pupa.

13. *Tenebrio molitor*: perfect insects. The larva known as the "meal-worm" is common in flour stores.

14. *Caradrina cubicularis*: perfect insect, and grains of wheat from a stack, which have been fastened together and devoured by the larvæ.

E. 132.—1886.

Insects injurious to Grass.

1, 2. *Agriotes lineatus*: perfect insects and enlarged drawing.

3-5. *Agriotes obscurus*: perfect insects and larvæ, with enlarged drawing of former.

6, 7. *Agriotes sputata*: perfect insects and enlarged drawing.

8. *Athous hæmorrhoidalis*: perfect insects.

9. *Melanotus rufipes*: perfect insects and larva.

10. *Lacon murinus*: perfect insects.

The larvæ of these beetles are known as "wire-worms."

They live for several years in the larval state eating the roots of grass and other plants.

11, 12. Drawings showing the mode in which the wire-worm attacks a root, and the burning of vegetable rubbish to destroy them.

13-15. *Melolontha vulgaris* (cockchafer); perfect insect, with drawings of larva and pupa.

15A. *Phyllopertha horticola* (small cockchafer): perfect insects.

16. Various species of carnivorous ground beetles, which feed upon the cockchafer and other insects.

17-20. *Tipula*, sp. (daddy-long-legs); perfect insects, with diagrammatic model showing how the grubs (known as "leather jackets") attack the plant.

21, 22. *Gryllotalpa vulgaris* (mole cricket): perfect insect, with drawing of its burrow and nest.

23-26. *Charæas graminis* (antler moth): perfect insects; drawing, and model of grass with larva.

27-30. *Tryphæna pronuba* (yellow underwing): perfect insects and drawing, larvæ and pupa.

31-36. *Odonestis potatoria* (drinker): perfect insects and drawings; larvæ and cocoon.

37. *Pimpla grammellæ*: parasitic on the larvæ of *Odonestis potatoria*.

38-51. *Noctuadæ* (night-flying moths): the larvæ of these feed after dark in sheltered places upon grass, as well as on certain crops and garden plants.

38-40. *Hepialus lupulinus* (common swift moth): perfect insects; drawing and larva attacking grass root.

41-44. *Xylophasia rurea*: perfect insects; drawing and larva on grass.

45-47. *Xylophasia polyodon*: perfect insects: drawing and larva on grass.

48-51. *Noctua xanthographa*: perfect insects, drawing; larvæ on grass and pupa.

52-54. *Cecidomyia tritici* (wheat midge): enlarged drawings of perfect insect, larva and pupa. (See also Insects injurious to Wheat, No. 6.)

55. *Siphonaria granaria* (corn aphid): enlarged drawings of apterous and winged females, and of pupa.

56, 57. *Rhopalotomus ater* (plant bug): perfect insects, and enlarged drawing of same.

E. 136.—1886.

Insects injurious to Apples.

1. *Scolytus rugulosus* (bark beetle): perfect insects and piece of wood bored by them; with drawing of insect (enlarged) and its burrows.

2. *Aphis* (*Eriosoma*) *lanigera* (American blight): root, branch, and leaf twigs of apple, cankered; enlarged drawings of queen aphid and young, pupa, and winged female, with an attacked twig.

3. *Anthonomus pomorum* (apple weevil): perfect insect and bud attacked by it, with enlarged drawings.

4. *Tenthredo testudinea* (saw-fly): young apples whose interior has been eaten out by the larva, with enlarged drawings of perfect insect and of fruit containing the larva.

5. *Melolontha* (*Anomala*) *horticola*: perfect insect, gnawing a young apple bud.

6. *Nemoicus oblongus* (brown weevil): perfect insects, gnawing apple buds and young fruit.

7. *Zeuzera asculi* (leopard moth): portions of stems with burrow and larva. (See also Insects injurious to Pears, No. 9.)

8. *Clisiocampa neustria* (lackey moth): perfect insects, eggs and larva, with nest of larvæ surrounded by their web.

9. *Aleyrodes* sp. (white-powdered fly): perfect insects on leaf.

10. *Wasps*: skin of an apple the interior of which was entirely eaten out by these insects.

11. *Tortrix pomonana* (codling moth): perfect insects with enlarged drawing; drawing of apple opened to show larva within it.

12. *Yponomeuta padella* (small ermine moth): perfect insects and larvæ in their web; enlarged drawings of perfect insect and larva.

13. *Coccus (Mytilaspis) conchiformis* (mussel scale): twigs attacked; enlarged drawings of female and of upper and under sides of scale.

E. 130.—1886.

Insects injurious to Mangold, Onion, and Potato.

A. Mangold.

1-7. *Anthomyia betæ* (mangold fly): perfect insects and pupæ; magnified drawings of perfect insect, larva and pupa; model of leaf showing blisters caused by the grub mining the leaf.

8-10. *Silpha opaca* and *S. atrata* (beet carrion beetle): perfect insects and drawings of larva, natural size and magnified.

11-15. *Plusia gamma* (silver Y-moth): perfect insects and drawing; larva and enlarged sketch of same; drawing of egg magnified.

16-21. *Hadena oleracea* (white-line moth); perfect insects and drawing, larvæ and pupa; sketches of ordinary brown larva and of green variety feeding on onions.

22, 23. *Atomaria linearis*: perfect insect and enlarged drawing.

24-27. Millipedes, which feed on roots of plants.

24, 25. *Julus pulchellus*: specimens and enlarged drawing.

26, 27. *Julus terrestris*: enlarged drawing.

28, 29. *Aphis papaveris*: specimens of perfect insect; enlarged drawings of winged, apterous, and young females.

B. Onion.

30, 31. *Chortophila platyura*: specimens and magnified drawing of perfect insect.

32-40. *Anthomyia ceparum*: specimens of perfect insect, larva and pupa, with enlarged drawings of them and sketches showing the larvæ feeding inside an onion, and the position in which eggs are sometimes laid; model of an onion attacked by grubs.

- Agrotis segetum*. (See Insects injurious to Turnip, No. 5.)
Hadena oleracea. (See Insects injurious to Mangold, Nos. 16-21.)

C. Potato.

41-44. Beetles whose larvæ, known as "wire-worms," feed upon roots.

41. *Agriotes lineatus*: perfect insect; the larvæ of this form feed on the potato. (See Insects injurious to Grass, Nos. 1, 2.)

42. *Agriotes obscurus*: perfect insects; the larvæ of this form feed on the potato. (See Insects injurious to Grass, Nos. 3-5.)

43, 44. *Melanotus rufipes*: perfect insects and larvæ; the larvæ of this form feed on the potato. (See Insects injurious to Grass, No. 9.)

45, 46. *Melolontha vulgaris*: perfect insects, male and female. (See Insects injurious to Grass, Nos. 13-15.)

47-52. *Acherontia atropos* (death's head hawk moth): perfect insect and drawing of same; larvæ and drawings of its pale and dark varieties; pupa.

53-60. Plant bugs which suck vegetable juices.

53, 54. *Deræocerus bipunctatus*: perfect insect and enlarged drawing.

55, 56. *Lygus pabulinus*: perfect insect and enlarged drawing.

57, 58. *Lygus contaminatus*: enlarged drawing.

59, 60. *Lygus umbellatorum*: perfect insect and enlarged drawing.

E. 137.—1886.

Insects injurious to Cabbage.

1. *Ceutorhynchus sulcicollis* (cabbage gall weevil): perfect insects and cocoons; enlarged drawings of perfect insect, larva and pupa in cocoon; young cabbage and stems of larger plants with root galls.

2. *Pieris brassicæ* (large white cabbage butterfly): perfect insects, male and female, larvæ and pupa, with enlarged drawing of last and of eggs.

Microgaster glomeratus (Ichneumon fly): parasitic insect, the larvæ of which feed on the entrails of the larva of *Pieris brassicæ*. Enlarged drawing of insect, perfect insects, cocoons, and infested larva.

3. *Pieris rapæ* (small white cabbage butterfly): perfect insects, male and female; larvæ and pupæ, with enlarged drawing of last; model of cauliflower infested by larvæ.

Pteromalus puparum: perfect insects, with enlarged drawing; larvæ, which are parasitic, on the larva of *Pieris rapæ*.

4. *Mamestra brassicæ* (cabbage moth); perfect insects, larvæ, and pupæ; drawings of larva in earthen cell and pupa in cocoon: model of cabbage-leaf gnawed by larvæ.

5. *Triphæna pronuba* (yellow underwing moth): perfect insects, larvæ, and pupa; enlarged drawings of larva and pupa in their earthen cells.

6. *Aphis brassicæ*: perfect insects and enlarged drawings of apterous and winged females and young; cabbage plant and leaves destroyed by these aphides.

7. *Aleyrodes proletella*: enlarged drawings of perfect insect and pupa; with infested leaves.

8. *Pieris napi* (green-veined white butterfly): perfect insects, larva, and pupæ, with enlarged drawing of the last.

E. 131.—1886.

Insects injurious to Carrots and Turnips.

A. Carrots.

1. *Depressaria depressella*: enlarged drawings of perfect insect and larva; sketch of larva on umbel of carrot; it spins threads about the umbel and devours the seeds and stems.

2. *Agrotis segetum*: model of carrot gutted by the larva, which was caught in the act of escaping.

3. *Hepialus fuscus* (brown swift moth): perfect insect, with enlarged drawing of same and of larva.

4. *Polydesmus complanatus*: enlarged drawing. This millipede and the next gnaw the roots of many garden vegetables.

5. *Julus (Blaniulus) pulchellus*: enlarged drawing.

6. *Psila rosæ*: magnified drawing of perfect insect and of larva; sketch of carrot infested; the exterior is gnawed, producing rust, and the larva buries itself in the root head first.

B. Turnips.

1. *Silpha opaca*: perfect insect and larva; enlarged drawings of same; sketch of larva on a turnip leaf.

2. *Haltica nemorum* (turnip fly or flea beetle); perfect insects; enlarged drawings of same and of larva; leaves gnawed by the larva and sketch of the burrow formed by it.

3. *Athalia spinarum* (turnip saw-fly): perfect insects and enlarged drawings of same and of larvæ on leaf. Leaf which has been attacked. The larva is known as "black jack" or "nigger."

4. *Agrotis exclamationis*: model of turnip gnawed by the underground larvæ.

5. *Agrotis segetum*: moths, larva, and drawing of larva.

6. *Cerostoma xylostella* (diamond-backed moth); perfect insect, with enlarged drawing; sketch of larva and cocoon on leaf.

7. Model of turnip with incipient swellings, probably due to attacks of insects in a younger state.

E. 133.—1886.

Insects injurious to Fir-trees (Timber and Foliage).

1-4. *Lachnus pinicolus*: perfect insects and larvæ, with enlarged drawing of the same.

5-7. *Chermes laricis*: perfect insects and infested branch; enlarged drawings of globule of resin with cotton, female depositing eggs on larch leaf and pseudova deprived of their cotton-like covering.

8-15. *Chermes abietis*: perfect insects and gall after the escape of the flies; model of gall; enlarged drawings of perfect insect, larva, and pupa, as well as of a gall from outside and in section; sketch of twig with incipient gall.

16-18. *Adelges piceæ*: bark with secretion left by insects; infested twig and sketch of infested branch.

19, 20. *Otiorhynchus fuscipes*: perfect insects and enlarged drawing.

21. *Rhagium bifasciatum*: perfect insect.

22, 23. *Rhagium inquisitor*: perfect insect and slightly enlarged drawing of larva.

24-30. *Fidonia piniaria* (bordered white moth): perfect insects and drawings.

31-38. *Liparis monacha* (black arches moth): perfect insects and drawings of same; sketch of eggs on bark and of caterpillar on branch of tree; pupa.

39-43. *Trachea piniperda* (pine beauty moth): perfect insects and drawings, larva on twig; sketches of eggs on leaf.

44-45. *Retinia buoliana* (pine shoot tortrix): perfect insects with enlarged drawing.

46. *Retinia turionana*: sketch of pine bud with larva inside.

47-53. *Lophyrus pini* (pine saw-fly): enlarged drawings of perfect insect, male and female, larva and pupa; cocoon.

54-57. *Sirex juvenicus* (steel-blue sirex): perfect insects with enlarged sketch of larva; timber bored by latter.

58-61. *Sirex gigas* (giant sirex): perfect insects, male and female, and larva; timber bored by the latter.

E. 138.—1886.

Insects injurious to Fir-tree (Bark).

1-3. *Pissodes notatus*: perfect insects with enlarged drawing and sketch of injured branch.

4, 5. *Pissodes pini*: perfect insect and enlarged drawing.

6-8. *Hylobius abietis*: perfect insects with enlarged drawing of same and of larva.

9, 10. *Hylastes palliatus*: enlarged drawings of perfect insect and of larva.

11-22. *Hylurgus piniperda*: perfect insects, and larvæ and pupæ, with enlarged drawings of same; pieces of bark and young branch showing excavated galleries; leaf twigs bored down the centre, with sectional drawing of same.

23, 24. *Hylurgus ater*: perfect insects and enlarged drawing.

25-27. *Anobium molle*: perfect insects and enlarged drawing; timber riddled by the larvæ.

28-30. *Spondylis buprestoides*: perfect insects and magnified drawing.

31-38. *Tomicus chalcographus*: perfect insect, with drawings of same, and of larva and pupa; drawings showing the borings of the larvæ.

39-41. *Tomicus laricis*: perfect insect and enlarged drawing; piece of bark showing the excavated galleries.

42-44. *Tomicus stenographus*: perfect insect and enlarged drawing; piece of bark showing excavated galleries.

45-50. *Tomicus typographus* (typographer bark beetle): perfect insects, with drawings of same and of larva and pupa; piece of bark showing excavated galleries.

51, 52. *Tomicus acuminatus*: perfect insect and enlarged drawing.

53-55. *Cryphalus abietis*: perfect insect and enlarged drawing; piece of bark showing excavated galleries.

E. 139.—1886.

Insects injurious to Roses.

1. *Emphytus cinctus* (banded saw-fly): twigs showing burrows of the larva.

2. *Athalia rosæ*: leaves injured by the larvæ.

3. *Hylotoma rosarum*: perfect insects, larva and cocoon; leaves devoured by the larvæ.

4. *Selandria aethiops* (rose-leaf saw-fly); enlarged drawing of perfect insect and leaves whose upper surface has been eaten away by the larvæ. See *Insects injurious to Pears*, No. 2.

5. *Lyda inanita* (leaf-rolling saw-fly): enlarged drawings of perfect insect, of larva, and of leaf-tube which it inhabits.

6. *Cladius difformis* (branch-horned saw-fly): enlarged drawing of perfect insect; leaves perforated by the larva.

7. *Tortrix* (*Argyrotoza*) *Bergmanniana*: perfect insects and enlarged drawing; leaves rolled up in spring by the larvæ.

8. *Cetonia aurata* (rose chafer): perfect insect, which eats petals and pollen of roses.

9. *Pemphredon* sp. (small wood-wasp): rose stems bored by the insect.

10. *Siphonophora rosæ* (green fly): perfect insects, with enlarged drawings of winged and apterous female and young.

11. *Anomala horticola*: perfect insects.

12. *Liparis auriflua*: (gold-tailed moth): perfect insects; the larva eats the leaves and flowers of roses.

13. *Nepticula anomalella* (rose-leaf miner): perfect insect with enlarged drawings of same, and of larva; specimen, and also sketch of leaf with borings.

14. *Otiorhynchus sulcatus* (brown weevil): perfect insects; they gnaw the young buds of the roses.

15. *Megachile centuncularis* (leaf-cutter bee): perfect insects with enlarged drawing; leaves with pieces cut out and cells formed from them in pieces of rotten wood.

16. Rose-leaf with globular galls.

17. *Rhodites occidentalis*: gall on wild rose of Utah.

18. *Rhodites rosæ*: perfect insect with enlarged drawing; specimens of galls and enlarged drawing of one in section.

19. *Rhodites bicolor*: rose twig from California with galls.

20. *Rhodites echinus*: twig of wild rose from Utah with galls.

E. 134.—1886.

Insects injurious to Oak (Timber).

1-11. *Cossus ligniperda* (goat moth): perfect insects, male and female; larvæ at various stages of growth; some in winter quarters, pupa and cocoon; piece of bark with ejected matter indicating the presence of caterpillars; pupa case after exit of moth; piece of timber with borings.

12-17. *Dorcus parallelopipedus* (lesser stag-beetle): perfect insects, with larva; pupa *in situ*; pieces of timber with beetles in borings.

18-21. *Lucanus cervus* (stag-beetle): perfect insects, male and female; sketches of larva and of earth-cocoon of pupa.

22-26. *Lymexylon navale*: perfect insects, with enlarged drawing of them and of larva; sketch of piece of wood with excavated galleries.

27-28. *Prionus coriarius*: perfect insects; the larva attacks wood as in the case of *Dorcus*.

29-32. *Sinodendron cylindricum* (rhinoceros beetle): perfect insects and enlarged drawings, male and female.

33-37. *Oryctes nigricornis*: perfect insects, larva and pupæ, with portions of earth-cocoon; not British, but sometimes introduced with timber.

38, 39. *Hammaticherus cereo*: perfect insects, male and female.

40-48. *Hammaticherus heros*: perfect insects, male and female, eggs and larva; gnawings and droppings of larva;

enlarged drawings of egg and pupa; timber with borings of larva.

E. 142.—1886.

Insects injurious to Oak (Sap and Bark).

1-3. *Callipterus querceus*: perfect insects and larvæ, with enlarged drawings of winged male and female and apterous female.

4-6. *Phylloxera quercus*: perfect insects and larvæ, with enlarged drawings of different stages of development.

7-9. *Dryobius roboris*: perfect insect and larva; enlarged drawings of winged male and apterous female; of female depositing eggs on bark, and of single egg.

10-21. Plant-bugs which suck the juices of the trees.

10, 11. *Globiceps flavonotatus*: perfect insects and enlarged drawing.

12, 13. *Deræocerus striatellus*: perfect insects and enlarged drawing.

14, 15. *Anthocoris nemorum*: perfect insect and enlarged drawing.

16-19. *Topicoris rufipes*: perfect insect and larva with enlarged drawings.

20, 21. *Pentatoma dissimile*: perfect insects and enlarged drawing.

22-33. *Scolytidæ* (bark-mining beetles):

22-24. *Scolytus rugulosus*: perfect insect and enlarged drawing; piece of wood showing borings. This species also attacks the apple.

25-30. *Scolytus multistriatus*: perfect insects and enlarged drawing of same, as well as of larva and pupa; pieces of bark showing borings.

31-33. *Scolytus intricatus*: perfect insect and enlarged drawing; part of a branch showing borings.

34, 35. *Hyphophlæus fasciatus*: perfect insect and enlarged drawing; this species and the next feed upon the wood-boring larvæ, and should not be destroyed.

36-38. *Hypophlæus bicolor*: perfect insects with enlarged drawing of same and of larva.

39-46. *Anobiidæ* (death-watch beetles):

39. *Anobium striatum*, specimens of.

40-44. *Anobium tessellatum*: perfect insects and larva, with enlarged drawings of same; piece of wood showing borings.

45, 46. *Ptilinus pectinicornis*: perfect insects and enlarged drawing.

E. 143.—1886.

Insects injurious to Oak (Foliage).

1-6. *Bombyx quercus* (oak eggar moth) : perfect insects, male and female, with drawings ; eggs, larvæ, and cocoon.

7-9. Perfect insects and enlarged drawing ; leaves folded by the larvæ.

10-14. *Hybernica defoliaria* (mottled umber) : perfect insects, male and apterous female, with drawings ; larvæ.

15. *Aptesis nigrocincta* : this and the next are parasitic flies which prey upon *Hybernica defoliaria*.

16. *Agryplon flaveolatum* : perfect insect.

17-19. *Hybernica aurantiaria* : perfect insects ; male and apterous female, with sketch of former.

20-23. *Cheinatobia brumata* (winter moth) : perfect insects, male and apterous female, with drawings ; larvæ on a twig.

24-27. *Phigalia pilosaria* (pale brindled beauty) : perfect insects, male and apterous female, with drawings of same ; larvæ on leaves.

28-35. *Orgyia antiqua* (vapourer moth) : perfect insect, with drawings ; eggs, with enlarged drawing ; cocoon, and larvæ on leaves.

36-40. *Pygæra bucephala* (buff-tip) : perfect insects ; sketch of moth resting on birch twig to show its resemblance to one ; larvæ and pupa.

41. *Pimpla instigator* : perfect insect ; parasitic on *Pygæra bucephala*.

42-45. *Amphydasis betularia* (peppered moth) : perfect insects, male and female ; larva and pupa.

46-53. *Orgyia pudibunda* (pale tussock moth) : perfect insects, male and female, with drawings ; eggs, larvæ, pupa, and cocoon.

54-56. *Attelabus curculionides* : perfect insects, with enlarged drawing ; leaves rolled up by beetle as habitations for its larvæ.

57, 58. *Melolontha vulgaris* (cockchafer) : perfect insects. The beetles gnaw the leaves of the oak. [See also Insects injurious to Grass, Nos. 13-15.]

59-65. *Balaninus glandium* (acorn weevil) : perfect insects and larvæ, with enlarged drawings ; sketches of infested acorns and of sections of same ; earth cocoons of pupæ.

E. 144.—1886.

Insects injurious to Oak (Galls).

1-6. *Cynips kollari* (marble-gall) : perfect insects and enlarged drawings ; galls, with one in section ; sketches of gall and of the conglomerate form of it.

7-10. *Dryophanta scutellaris* (cherry-gall) : perfect insects and enlarged drawing ; gall *in situ* and sketch showing one in section.

11-14. *Andricus terminalis* (oak-apple): perfect insects and enlarged drawing: gall *in situ* and sketch showing one in section.

15-18. *Andricus ramuli* (cotton-gall): perfect insect and enlarged drawing; gall and sketch of same.

19-22. *Andricus curvator* (leaf-twister-gall): perfect insect and enlarged drawing; affected leaves and sketch of galls.

23-26. *Aphilothrix gemmæ* (artichoke-gall): perfect insect and enlarged drawing; galls and sketch of same showing one in section.

27-30. *Aphilothrix radicis* (root-gall): perfect insects and enlarged drawing; gall in section and sketch of same.

31-35. *Neuroterus*, sp. (oak spangles): perfect insect and enlarged drawing; leaf with galls, and sketches of two species of the same (*N. lenticularis* and *N. numisatis*).

36-39. *Spathegaster baccarum* (currant-gall): perfect insect and enlarged drawing; models of gall on leaf, and drawings of same on leaf and on catkin.

E. 141.—1886.

Insects injurious to Hops.

1, 2. *Phorodon humuli* (hop aphid): perfect insect and enlarged drawings of winged male and female, apterous female and pupa.

3-14. Insects which destroy the hop aphides.

3-8. *Coccinellæ*, spp. (ladybird beetles): various species, with larvæ and enlarged drawing of same.

9-11. *Syrphus*, sp. (hovering fly): perfect insect; drawing of larvæ, natural size and enlarged seizing aphid.

12-14. Lace-wing fly: perfect insects; drawings of eggs and of larvæ known as "aphis-lion."

15-21. *Tetranychus telarius* (red spider): specimens of the mite; enlarged drawings of red and green varieties, and of immature stage; infested leaves.

22, 23. *Euacanthus interruptus*: perfect insect, enlarged drawings of red and yellow varieties.

24, 25. *Lygus umbellatarum* (hop bug): perfect insect and enlarged drawing.

26-28. *Haltica* (*Plectroscelis*) *concinna* (hop flea-beetle): perfect insect, with enlarged drawing; affected leaf. The beetles gnaw holes in the leaf and the larvæ burrow between its upper and lower surfaces.

29-34. *Hepialus humuli* (otter moth, or ghost swift): perfect insects, male and female, with drawings; larva and pupa.

35-40. *Orgyia pudibunda* (hop-dog or pale tussock moth): perfect insects, male and female, with drawings; larvæ and leaf attacked by them. [See also *Insects injurious to Oak Foliage*, Nos. 46-53.]

41-45. *Dilophus vulgaris* (hop-cone fly): perfect insects, with drawings of insects and of larva; piece of an affected plant. The larvæ attack the roots, the flies the cones.

46, 47. *Agriotes lineatus*: perfect insect and larvæ; also larvæ of other species. [See also Insects injurious to Potato, No. 41.]

48. *Julus*, sp. This and the two following millipedes gnaw the tender roots.

49. *Polydesmus complanatus*.

50. *Julus pulchellus*: drawing, natural size and enlarged.

E. 140.—1886.

281. Water-colour sketches showing the injury done to Scotch fir and spruce fir by various parasites.

1. Scotch fir destroyed by *Hylesinus piniperda*.

2. Spruce fir injured by *Sesia cephiformis*.

3. Scotch fir injured by *Tortrix buoliana*.

4. Scotch fir destroyed by *Noctua piniperda*.

282. Water-colour sketches showing the injury to Scotch fir and larch by various parasites.

1. Scotch fir injured by *Hylesinus piniperda*.

2. Larch injured by *Coleophora laricella*.

3. Scotch fir injured by *Geometra piniaria*.

4. Scotch fir injured by a small *Tenthredo*.

283. Diagrams (six) showing enlarged representations of insects injurious to farm crops.

Prepared by Miss E. A. Ormerod for the Royal Agricultural Society.

1884.

C. MODELS.

284. Model of a "bordered pit" from the wood of a conifer; highly magnified.

E. 150.—1888.

Made by F. S. Leach.

The upper half of the model can be lifted out to show the closing membrane of the pit.

285. Model of the apex of the thallus of *Metzgeria furcata* to show the arrangement and mode of division of the cells in a growing point with a bilateral apical cell.

E. 160.—1888.

Made by F. S. Leach.

Black indicates the principal walls of the segments.

Red " the first division in each segment.

Green " the second division in each segment.

286. Model of the pyramidal apical cell from a shoot of *Equisetum*; highly magnified.

E. 161.—1888.

Made by *F. S. Leach*.

287. Model of a stoma from a leaf; highly magnified.

E. 162.—1888.

Made by *F. S. Leach*.

The model can be separated into four parts to show the form and relations of the two sausage-shaped guard-cells.

288. Models illustrating the arrangement of the fibro-vascular bundles in the stems of different types of plants.

Made by *F. S. Leach*.

1. Fern (*Osmunda*). E. 155.—1888.
2. „ (*Aspidium*). E. 158.—1888.
3. Horse-tail (*Equisetum*). E. 157.—1888.
4. Conifer (*Juniperus*). E. 152.—1888.
5. Ranunculaceæ (*Clematis*). E. 151.—1888.
6. Palmaceæ (*Palm*). E. 159.—1888.
7. Fern (*Davallia*). E. 153.—1888.
8. Cruciferæ (*Iberis*). E. 154.—1888.
9. Leguminosæ (*Phaseolus*). E. 156.—1888.

289. A model of *Micrococcus Crepusculum*, magnified 20,000 diameters, showing the form which appears in certain boiled foods, such as potatoes.

E. 32.—1884.

Made by *R. Brendel, Berlin*.

290. A model of *Bacterium Termo*, Duj., the putrefaction ferment; magnified 10,000 diameters.

E. 32a.—1884.

Made by *R. Brendel, Berlin*.

One model shows the ordinary condition of the organism, another incipient segmentation, whilst in the third the segmentation has already taken place.

291. A series of six models illustrating the life history of *Bacillus subtilis* Cohn., on four stands; magnified 25,000 diameters.

E. 32b to e.—1884.

Made by *R. Brendel, Berlin*.

- a. The swarm-stage with two flagella.
- b. The full-grown *Leptothrix* condition, with incipient formation of spores.
- c. A free spore.
- d. Spore beginning to germinate.
- e. The spore which has already germinated.
- f. Origin of new threads from the spore.

292. Model of *Spirillum volutans*, Cohn.; enlarged 15,000 diameters.

E. 32f.—1884. *Made by R. Brendel, Berlin.*

Showing a thread consisting of three segments with two flagella.

293. Model of *Spirochæte Obermeieri*, Cohn., the germ of relapsing fever; magnified 10,000 diameters.

E. 32g.—1884. *Made by R. Brendel, Berlin.*

Two distinct forms are shown, mounted on the same stand.

294. Set of six models illustrating the morphology and life history of *Saccharomyces cerevisiæ*, Meyen, the yeast plant; highly magnified.

E. 31a to e.—1884. *Made by R. Brendel, Berlin.*

1, 2. Yeast of the lower fermentation. The yeast cells are isolated or have only one small bud growing from them.

3. Yeast of the higher fermentation. The cells are connected with strings.

4. Daughter-cells in groups of four within the mother-cell.

5. Free daughter-cells (spores) before germination.

6. Spores germinating.

295. Enlarged model of the Sporogonium of a moss (*Polytrichum commune*).

E. 135.—1874. *Made by the late Dr. Auzoux, Paris.*

The hairy calyptra, the operculum, and the epiphragm are all movable, and the walls of the theca can be separated to show the cavity with its contained spores.

296. Enlarged model of a grain of wheat (*Triticum aestivum*, L.).

E. 134.—1874. *Made by the late Dr. Auzoux, Paris.*

The model can be bisected to exhibit the internal structure; the embryo, which is in sections, can be taken out, and replaced by a second model of the embryo showing its appearance in a more advanced stage of growth.

297. Enlarged model of the spikelet of wheat (*Triticum vulgare*, L.).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 9.—1891.

The glumes and two complete florets can be removed, showing the nectaries, stamens, and pistil. The whole spikelet is first to be detached from the stem.

298. Enlarged model of the flower and fruit of the pink (*Dianthus plumarius*).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 1.—1889.

The calyx can be drawn out from the surrounding bracts, and the inner floral organs again from it. Two of the petals and three of the stamens are also movable, to show the pistil. One of the styles and part of the wall of the ovary may then be lifted out to expose the ovules within. The fruit splits longitudinally to show the ripe placenta and the black irregularly-shaped seeds attached to it.

299. Enlarged model of a part of a plant of the wild stock (*Matthiola incana*).

E. 140.—1874. *Made by the late Dr. Auzoux, Paris.*

The model shows several buds in different stages of development. In the complete flower the calyx swings back on hinges, and two of the petals and two of the long stamens can be removed to show the arrangement of the floral organs. The ripe pod can be opened down one side to show the contained seeds.

300. Enlarged model of a portion of the plant of the sweet pea (*Lathyrus odoratus*).

E. 139.—1874. *Made by the late Dr. Auzoux, Paris.*

The model shows several leaves with tendrils and a partly opened bud, as well as a fully expanded flower. The calyx of this last can be removed, as well as the petals, the carina being separable into two portions. The odd superior stamen can be taken out by itself and the fused stamens in a piece, leaving the pod-shaped pistil in the centre.

301. Enlarged model of the unripe pod of pea (*Pisum sativum*).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 1.—1891.

The wall is partly dissected away to show the vascular system in it, and the pod opens showing the minute structure of the ovules at the time of fertilization. The pollen tubes are shown.

302. Enlarged model of the ripe pod of pea.

Made by Montaudon (late Dr. Auzoux), Paris.

E. 2.—1891.

The pod opens showing the seeds, one of which itself opens to show the seminal envelopes and embryo.

303. Enlarged model of the cherry (*Prunus cerasus*), ripe drupe.

Made by Montaudon (late Dr. Auzoux), Paris.

E. 11.—1891.

A part of the epicarp is dissected away to show the mesocarp (= sarcocarp), with its vascular bundles. Half the fruit can be detached, showing the stony endocarp. This opens, disclosing the testa of the seed, which itself opens to show the embryo, consisting of two cotyledons, plumule, and radicle. Note that the part marked "embryon" seen on opening the cotyledons is the plumule.

304. Enlarged model of the "fruit" of strawberry (*Fragaria vesca*, L.).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 13.—1891.

Cut vertically to show the succulent receptacle, vascular system, and dry 1-seeded achenes. The persistent calyx and epicalyx are shown; also the withered petals and stamens.

305. Enlarged model of the flower of the deadly night-shade (*Atropa Belladonna*).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 3.—1889.

One side of the calyx is movable, and the corolla can be lifted from its place and opened longitudinally to show the arrangement of the stamens within.

306. Enlarged model of the fruit of the deadly night-shade (*Atropa Belladonna*).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 4.—1889.

The berry can be opened in the middle to show the axile placentation of the seeds in the interior.

307. Enlarged model of the calyx and fruit of *Hyoscyamus niger* (*Solanaceæ*).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 6.—1891.

The calyx can be opened, and the capsule detached. The lid opens, and the capsule is divided both transversely and longitudinally to show the axile placentation.

308. Enlarged model of the flower-bud, flower, and capsule of snapdragon (*Antirrhinum majus*, L.).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 3.—1891.

The whole flower can be detached. The corolla can then be taken in half, showing the didynamous stamens (which are removable) and the pistil, the stigma of which can be opened.

The right capsule shows the porous dehiscence, and can be opened to show the seeds on the axile placentas.

309. Enlarged model of the flower of woody nightshade (*Solanum dulcamara*, L.), showing all the parts.

Made by Montaudon (late Dr. Auzoux), Paris.

E. 4.—1891.

The calyx can be opened, and two petals and stamens removed.

310. Enlarged model of a gooseberry (*Ribes uva crispia*, L.).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 14.—1891.

Divided to show the two parietal placentas, and the vascular bundles running out to the seeds. The whole inferior berry is surmounted by the persistent calyx and corolla, and the remains of the stamens.

311. Enlarged model of the mulberry (*Morus nigra*, L.).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 15.—1891.

Shows the sorosis or compound fruit, longitudinally bisected. A single fruit is divided so as to show the pericarp, albuminous seed, and embryo. In another fruit the succulent sepals can be removed, showing the ovary.

312. Enlarged model of the flower and flower-bud of lily (*Lilium*).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 5.—1891.

In the former two sepals and one petal can be removed, one of the stamens swings out on a hinge, and one side of the tricarpellary ovary can be opened to show the axile placentation of the ovules. The entire flower can be detached.

313. Enlarged model of the seed of yew (*Taxus baccata*, L.), with bracts (termed "calice persistant" on the model).

Made by Montaudon (late Dr. Auzoux), Paris.
E. 8.—1891.

The red arillus opens, as also does the seed itself, disclosing the embryo and endosperm (marked "perisperme.")

314. Enlarged model of the flower of comfrey (*Symphytum officinale*).

Made by Montaudon (late Dr. Auzoux), Paris.
E. 16.—1891.

The corolla can be removed and then opens on a hinge, disclosing the ligules and stamens. The calyx and pistil remain behind, and the former opens to show the bicarpellary ovary, which is four-lobed and contains four seeds.

315. Enlarged model of the male flower of the melon (*Cucumis Melo*).

Made by Montaudon (late Dr. Auzoux), Paris.
E. 6.—1889.

One half of the flower is mounted on a hinge, so that it can be opened to show the interior.

316. Enlarged model of the female flower of the melon (*Cucumis Melo*).

Made by Montaudon (late Dr. Auzoux), Paris.
E. 7.—1889.

One half of the perianth is hinged, and can be opened to show the interior of the flower; a third part of the ovarian wall also swings out of place, exhibiting the ovules in the interior, and a transverse section of the ovary may also be seen.

317. Enlarged model of the flower of the garden rampion (*Campanula Rapunculus*).

Made by Montaudon (late Dr. Auzoux), Paris.
E. 2.—1889.

One side of the perianth swings out upon a hinge, showing the interior of the flower and of the ovary. One of the stamens can be taken out to show the base of the style. Half the corolla is also movable from the calyx.

- 318.** Enlarged model of part of the plant of a *Fuchsia*.
Made by Montaudon (late Dr. Auzoux), Paris.
 E. 5.—1889.

Several buds are shown in various stages of advancement. The expanded flower can be opened longitudinally, and the style with the placentæ at its base can be taken out to show the ovules. A mature fruit is also exhibited which may be opened, thus rendering visible the disposition of the ripe seeds.

- 319.** Enlarged model of a portion of a plant of the ox-eye daisy (*Chrysanthemum Leucanthemum*).
 E. 138.—1874. *Made by the late Dr. Auzoux, Paris.*

The model shows a bud and an expanded flower-head, in which the marginal florets of the disc have opened. This opens down the middle line to exhibit the form of the receptacle and the arrangement of the florets. Two of the disc-florets have had part of the corolla removed to render the internal structure visible, and one of the ray-florets can be taken from its place. Another part of the model shows the ripe receptacle with the seeds falling from it.

- 320.** Enlarged model of the ripe fruit of columbine (*Aquilegia vulgaris*, L.).
Made by Montaudon (late Dr. Auzoux), Paris.
 E. 7.—1891.

Shows the five dehiscent follicles, two of which can be detached, one opening by a hinge to show the seeds on the marginal placentas.

- 321.** Enlarged model of the flower of the dock (*Rumex Patientia*).
 E. 136.—1874. *Made by the late Dr. Auzoux, Paris.*

The calyx can be taken off to show the stamens and pistil in the centre.

- 322.** Enlarged model of the fruit of the dock (*Rumex Patientia*).
 E. 137.—1874. *Made by the late Dr. Auzoux, Paris.*

Two of the perianth-leaves can be removed, as also the ripe ovary, in one side of which an opening has been made to show the contents.

323. Enlarged model of a germinating acorn; the two cotyledons have separated, and the root, as well as the stem with its first leaves, is shown.

E. 133.—1874. *Made by the late Dr. Auzoux, Paris.*

324. Enlarged model of an acorn (fruit of *Quercus robur*, L.).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 10.—1891.

The wall of the fruit is shown partly dissected away to show the mesocarp and endocarp. The fruit opens disclosing the testa of the seed, which again opens to show the cotyledons of the embryo, and then also opens showing its plumule and radicle.

325. Enlarged model of the wood of oak (*Quercus communis*).

Made by Montaudon (late Dr. Auzoux), Paris.

E. 12.—1891.

Shows spiral vessels of the protocypen, annual rings of secondary wood, duramen and alburnum, medullary rays, cambium, bast, &c.

326. Series of models in gutta-percha, papier-mâché, and other materials to illustrate the structure of the flowers and reproductive organs of various plants.

Made by R. Brendel, Berlin.

1. *Equisetum arvense*: a fertile spike with sporangia. E. 105.—1880.

2. *Equisetum arvense*: a scale from the spike showing the sporangia beneath it; an embryo in the prothallium; two spores with their elaters. E. 107.—1880.

3. *Equisetum arvense*: the male and female prothallia, the former with antheridia, the latter with archegonia. E. 106.—1880.

4. *Pteris serrulata*: prothallium showing the section of an archegonium; sporangium bursting to show the spores escaping; spore still more enlarged; germinating spore. E. 108.—1880.

5. *Pteris serrulata*: prothallium with antheridia and archegonia; germinating spore, showing the commencement of the rhachis and the root. E. 109.—1880.

6. *Aspidium Filix-mas*: prothallium showing the antheridia and archegonia. E. 16.—1884.

7. *Aspidium Filix-mas*: prothallium with developing embryo. E. 17.—1884.

8. *Taxus baccata* : male and female flowers. E. 62.—1880.
9. *Pinus sylvestris* : female flower ; single scale from the flower showing the two ovules. E. 60.—1880.
10. *Pinus sylvestris* : male flower ; a single scale more enlarged showing the pollen sacs. E. 61.—1880.
11. *Lilium Martagon* : model of the flower. E. 101.—1880.
12. *Colchicum autumnale* : model of the flower and of the corm ; also of the fruit. E. 102.—1880.
13. *Galanthus nivalis* : model of the flower. E. 100.—1880.
14. *Galanthus nivalis* : dissected to show the stamens, style, and interior of the ovary. E. 22.—1884.
15. *Iris germanica* : model of flower. E. 99.—1880.
16. *Carex hirta* : male and female flowers. E. 103.—1880.
17. *Triticum vulgare* : flower as seen from without and dissected. E. 49.—1880.
18. *Secale cereale* : a whole flower and a dissected one ; the awns are made to take off for convenience in stowing. E. 50.—1880.
19. *Secale cereale* : germination of the seed ; the sprouting embryo is seen in section, more enlarged. E. 43.—1880.
20. *Secale cereale* : enlarged model of the seed ; portions of the three envelopes are movable, and by taking out a pin at the top the two sides fall down on hinges, leaving a thin section in the centre ; near one end is the embryo, which can be taken out so as to show its external form. E. 30.—1884.
21. *Hordeum distichum* : a whole and a dissected flower. E. 51.—1880.
22. *Avena sativa* : a whole and a dissected flower. E. 52.—1880.
23. *Poa pratensis* : model of part of a spike. E. 104.—1880.
24. *Orchis Morio* : model of flower. E. 98.—1880.
25. *Butomus umbellatus* : model of flower. E. 121.—1880.
26. *Betula alba* : male and female flowers. E. 21.—1884.
27. *Quercus Robur* : male and female flowers ; one of the latter in section. E. 64.—1880.
28. *Salix alba* : male and female flowers. E. 63.—1880.
29. *Urtica dioica* : male and female flowers. E. 97.—1880.
30. *Polygonum Fagopyrum* : model of flower. E. 18.—1884.
31. *Chenopodium album* : model of flower. E. 94.—1880.
32. *Dianthus Caryophyllus* : model of flower. E. 69.—1880.
33. *Ranunculus acris* : model of flower. E. 65.—1880.
34. *Aconitum Napellus* : model of flower. E. 66.—1880.
35. *Nymphaea alba* : model of flower. E. 120.—1880.
36. *Papaver Argemone* : model of flower and of opening bud. E. 67.—1880.
37. *Fumaria officinalis* : model of flower. E. 27.—1884.
38. *Brassica napus* : model of flower. E. 45.—1880.
39. *Brassica napus* : seed pod. E. 46.—1880.

40. *Viola tricolor*: model of whole flower and of one in section. E. 68.—1880.
41. *Drosera rotundifolia*: model of leaf, with small fly caught in hairs. E. 111.—1880.
42. *Aldrovanda vesiculosa*: model of part of stem and of three leaves, wide open, closing and shut. E. 115.—1880.
43. *Dioncæa muscipula*: model of leaf, with fly. E. 112.—1880.
44. *Sarracenia purpurea*: model of leaf. E. 114.—1880.
45. *Nepenthes distillatoria*: model of leaf. E. 110.—1880.
46. *Hypericum perforatum*: model of flower. E. 71.—1880.
47. *Tilia parvifolia*: model of flower. E. 119.—1880.
48. *Malva sylvestris*: model of flower and of the central parts of another to show stamens and pistil. E. 70.—1880.
49. *Geranium phæum*: models of flower and of ripe fruit. E. 72.—1880.
50. *Linum usitatissimum*: model of flower. E. 47.—1880
51. *Ruta graveolens*: models of flower and of fruit. E. 73.—1880.
52. *Polygala comosa*: model of flower. E. 29.—1884.
53. *Vitis vinifera*: model of flower, with separating bud-scales. E. 55.—1880.
54. *Rhamnus Frangula*: model of flower. E. 74.—1880.
55. *Euphorbia Cyparissias*: model of flower. E. 96.—1880.
56. *Conium maculatum*: model of flower and of ripe fruit. E. 79.—1880.
57. *Sedum acre*: model of flower. E. 78.—1880.
58. *Saxifraga granulata*: model of flower. E. 26.—1884.
59. *Parnassia palustris*: model of flower. E. 28.—1884.
60. *Ribes Grossularia*: model of flower. E. 58.—1880.
61. *Ænothera biennis*: model of flower; part of the wall of the ovary opens to show its interior. E. 76.—1880.
62. *Lythrum Salicaria*: model of flower. E. 77.—1880.
63. *Daphne Mezereum*: model of two flowers; in one the perianth is divided down the middle. E. 95.—1880.
64. *Pyrus Malus*: model of flower which can be bisected to show internal structure. E. 56.—1880.
65. *Rosa canina*: model of flower and of the gynæceum bisected. E. 20.—1884.
66. *Fragaria vesca*: model of flower. E. 57.—1880.
67. *Sanguisorba officinalis*: model of flower, bisected to show its internal structure. E. 19.—1884.
68. *Prunus Cerasus*: model of flower, which can be divided into two parts to show the internal structure; also of the bisected pistil. E. 59.—1880.
69. *Pisum sativum*: model of flower. E. 54.—1880.
70. *Pisum sativum*: model of pod. E. 48.—1880.
71. *Phaseolus vulgaris*: models showing the process of germination, and the formation of the stem with the cotyledons and leaves. E. 44.—1880.

72. *Ononis hircina*: model of flower. E. 75.—1880.
73. *Calluna vulgaris*: model of flower. E. 25.—1884.
74. *Primula officinalis*: model of flower. E. 93.—1880.
75. *Syringa vulgaris*: model of flower. E. 118.—1880.
76. *Gentiana asclepiadea*: model of flower. E. 87.—1880.
77. *Vincetoxicum officinale*: model of flower. E. 86.—1880.
78. *Asclepias cornuti*: model of flower, which can be separated into two halves to show the internal structure. E. 117.—1880.
79. *Callistegia sepium*: model of flower. E. 88.—1880.
80. *Symphytum officinale*: model of flower; the corolla separated into two halves to show the position and arrangement of the stamens. E. 89.—1880.
81. *Atropa Belladonna*: model of flower. E. 90.—1880.
82. *Solanum tuberosum*: model of flower, parts of which can be removed to show the structure. E. 53.—1880.
83. *Linaria vulgaris*: half the corolla can be removed to show the structure of the flower. E. 24.—1884.
84. *Digitalis purpurea*: model of the flower. E. 91.—1880.
85. *Salvia officinalis*: the corolla can be removed into two pieces, and the ovary and style taken out. E. 23.—1884.
86. *Stachys palustris*: model of flower. E. 92.—1880.
87. *Utricularia vulgaris*: model of bladder; part of one branch is separable to show the structures round the aperture. E. 113.—1880.
88. *Campanula rapunculoides*: model of flower. E. 85.—1880.
89. *Asperula odorata*: model of flower. E. 81.—1880.
90. *Lonicera Caprifolium*: model of flower. E. 80.—1880.
91. *Valeriana officinalis*: model of flower. E. 82.—1880.
92. *Succisa pratensis*: model of flower, separable into three parts. E. 83.—1880.
93. *Anthemis Cotula*: model of the flower-head bisected to show the receptacle and the arrangement of the bracts and florets; enlarged separate models of a floret of the disc and of the ray. E. 84.—1880.
94. *Taraxacum officinale*: model of the flower-head bisected in which one floret remains on the receptacle; a separate larger model of the floret, and another of the ripe fruit. E. 116.—1880.

D. DIAGRAMS AND PLANS.

327. Lecture diagrams. A series of nine, illustrating the principal facts in plant structure, and the chief natural orders, prepared by the late Professor Henslow with special reference to his course of botanical instruction for schools. Drawn by W. Fitch for the Science and Art Department. 1857.

Published by Chapman and Hall.

328. Lecture diagrams illustrating the main facts of plant structure. A set of four, 50 ins. by 42 ins., drawn up by the late Professor J. H. Balfour. Executed by W. and A. K. Johnston.

Lent by the late Professor Balfour. 1872.

Price 10s. each.

PLATE I. Organs and tissues of plants, roots, and stems.

PLATE II. Leaves and their modifications.

PLATE III. Inflorescence, whorls of the flower.

PLATE IV. Pistil, ovule, fruit, and seed. Organs of flowerless plants.

329. A series of 70 folio sheets illustrating the principal types of the vegetable kingdom by means of pictures, enlarged diagrams, and dried specimens, with letter-press diagrams and descriptive notes. Designed by Professor Oliver. Prepared for the Science and Art Department.

Published by Chapman and Hall. 1870.

The natural orders and types illustrated are as follows:—

Ranunculaceæ.	Buttercup (<i>Ranunculus bulbosus</i>), Clematis (<i>Clematis Vitalba</i>), Monkshood (<i>Aconitum Napellus</i>).
Berberidaceæ.	Barberry (<i>Berberis vulgaris</i>).
Nympheaceæ.	White Water-lily (<i>Nymphaea alba</i>).
Fumariaceæ.	Fumitory (<i>Fumaria officinalis</i>).
Papaveraceæ.	Poppy (<i>Papaver Rhæas</i>).
Cruciferae.	Wallflower (<i>Cheiranthus Cheiri</i>), Shepherd's purse (<i>Capsella Bursa-pastoris</i>), Honesty (<i>Lunaria annua</i>), Radish (<i>Raphanus sativus</i>).
Resedaceæ.	Mignonette (<i>Reseda odorata</i>).
Cistineæ.	Rock-rose (<i>Helianthemum vulgare</i>).
Violaceæ.	Pansy (<i>Viola tricolor</i>).
Polygalaceæ.	Milk-wort (<i>Polygala vulgaris</i>).
Caryophyllaceæ.	Carnation (<i>Dianthus Caryophyllus</i>).
Frankeniaceæ.	Sea Heath (<i>Frankenia levis</i>).
Hypericineæ.	St. John's Wort (<i>Hypericum perforatum</i>).
Ternstræmiaceæ.	Tea (<i>Thea chinensis</i>).
Malvaceæ.	Mallow (<i>Malva sylvestris</i>).
Tiliaceæ.	Lime-tree (<i>Tilia europæa</i>).
Linaceæ.	Flax (<i>Linum usitatissimum</i>).
Oxalidaceæ.	Wood Sorrel (<i>Oxalis Acetosella</i>).
Geraniaceæ.	Meadow Crane's-bill (<i>Geranium pratense</i>).
Tropæolaceæ.	Nasturtium (<i>Tropæolum majus</i>).

Rutaceæ.	Rue (<i>Ruta graveolens</i>), Zanthoxylum, Orange (<i>Citrus Aurantium</i>).
Ilicineæ.	Holly (<i>Ilex Aquifolium</i>).
Celastrineæ.	Spindle-tree (<i>Euonymus europæus</i>).
Rhamnaceæ.	Buck-thorn (<i>Rhamnus catharticus</i>).
Ampelideæ.	Vine (<i>Vitis vinifera</i>).
Acerineæ.	Sycamore (<i>Acer Pseudo-platanus</i>).
Hippocastaneæ.	Horse-chestnut (<i>Æsculus Hippocastaneum</i>).
Leguminosæ	Pea (<i>Pisum sativum</i>), Laburnum (<i>Cytisus Laburnum</i>), Acacia (<i>Acacia</i> , sp.).
Rosaceæ.	Sloe (<i>Prunus communis</i>), Bramble (<i>Rubus fruticosus</i>), Apple (<i>Pyrus Malus</i>), Cherry (<i>Prunus Cerasus</i>), Meadow sweet (<i>Spiræa Ulmaria</i>), Lesser Burnet (<i>Poterium Sanguisorba</i>), Dog-rose (<i>Rosa canina</i>), Hawthorn (<i>Cratægus oxyacantha</i>).
Saxifragaceæ.	Meadow Saxifrage (<i>Saxifraga granulata</i>).
Ribesiaceæ.	Red Currant (<i>Ribes rubrum</i>), Gooseberry (<i>R. Grossularia</i>), Red-flowered currant (<i>R. sanguineum</i>).
Crassulaceæ.	Stone-crop (<i>Sedum acre</i>).
Droseraceæ.	Sundew (<i>Drosera rotundifolia</i>), Venus' fly-trap (<i>Dionæa muscipula</i>).
Lythraceæ.	Purple Loosestrife (<i>Lythrum Salicaria</i>).
Myrtaceæ.	Myrtle (<i>Myrtus communis</i>), Brazil-nut (<i>Bertholletia excelsa</i>).
Onagraceæ.	Willow-herb (<i>Epilobium angustifolium</i>), Fuchsia (<i>Fuchsia</i> sp.).
Halorageæ.	Mare's Tail (<i>Hippuris vulgaris</i>), Starwort (<i>Callitriche verna</i>), Water-chestnut (<i>Trapa</i> sp.).
Cucurbitaceæ.	Bryony (<i>Bryonia dioica</i>).
Passifloreæ.	Passion-flower (<i>Passiflora cærulea</i>).
Umbelliferæ.	Hemlock (<i>Conium maculatum</i>), Cow-parsnip (<i>Heracleum Sphondylium</i>), Wild Chervil (<i>Chærophyllyum sylvestre</i>).
Araliaceæ.	Ivy (<i>Hedera Helix</i>).
Loranthaceæ.	Mistletoe (<i>Viscum album</i>).
Cornaceæ.	Dogwood (<i>Cornus sanguinea</i>).
Caprifoliaceæ.	Honeysuckle (<i>Lonicera Periclymenum</i>), Guelder Rose (<i>Viburnum Opulus</i>).
Campanulaceæ.	Hare-bell (<i>Campanula rotundifolia</i>), Canterbury Bell (<i>C. media</i>).
Lobeliaceæ.	Lobelia (<i>Lobelia Erinus</i>).
Ericaceæ.	Heath (<i>Erica cinerea</i>).
Rubiaceæ.	Woodruff (<i>Asperula odorata</i>), Coffee (<i>Coffea arabica</i>).

Valerianaceæ.	Valerian (<i>Valeriana officinalis</i>).
Dipsacæ.	Field Scabious (<i>Knautia arvensis</i>).
Compositæ.	Ox-eye Daisy (<i>Chrysanthemum Leucanthemum</i>), Bluebottle (<i>Centaurea Cyanus</i>), Dandelion (<i>Taraxacum officinale</i>).
Primulaceæ	Cowslip (<i>Primula veris</i>).
Plumbagineæ.	Thrift (<i>Armeria vulgaris</i>).
Oleaceæ.	Ash (<i>Fraxinus excelsior</i>), Lilac (<i>Syringa vulgaris</i>).
Gentianaceæ.	Gentianella (<i>Gentiana acaulis</i>).
Apocynaceæ.	Periwinkle (<i>Vinca major</i>).
Asclepiadaceæ.	(<i>Periploca græca</i>).
Convolvulaceæ.	Bindweed (<i>Convolvulus arvensis</i>), Dodder (<i>Cuscuta</i> sp.).
Polemoniaceæ.	Jacob's Ladder (<i>Polemonium cæruleum</i>).
Solanaceæ.	Deadly Nightshade (<i>Atropa Belladonna</i>), Potato (<i>Solanum tuberosum</i>).
Boraginaceæ	Forget-me-not (<i>Myosotis palustris</i>), Comfrey (<i>Symphytum</i> sp.).
Bignoniaceæ.	(<i>Bignonia</i> sp.).
Scrophulariaceæ.	Toad-flax (<i>Linaria vulgaris</i>), Foxglove (<i>Digitalis purpurea</i>), Germander Speedwell (<i>Veronica Chamædrys</i>).
Lentibulariæ.	Bladderwort (<i>Utricularia vulgaris</i>).
Labiataæ.	Sage (<i>Salvia officinalis</i>), White Dead-nettle (<i>Lamium album</i>).
Verbenaceæ.	Vervein (<i>Verbena officinalis</i>).
Plantaginaceæ.	Ribwort (<i>Plantago lanceolata</i>).
Chenopodiaceæ.	Good King Henry (<i>Chenopodium Bonus-Henricus</i>), Orache (<i>Atriplex</i>).
Amarantaceæ.	Prince's Feather (<i>Amarantus</i> , sp.).
Polygonaceæ.	Dock (<i>Rumex crispus</i>).
Thymelaceæ.	Spurge Laurel (<i>Daphne Laureola</i>).
Lauraceæ.	Bay Laurel (<i>Laurus nobilis</i>), Camphor (<i>L. Camphora</i>).
Santalaceæ.	Bastard Toad-flax (<i>Thesium linophyllum</i>).
Elæagnaceæ	<i>Elæagnus</i> sp.
Aristolochiaceæ.	Birthwort (<i>Aristolochia Clematitis</i>), Asarabacca (<i>Asarum europæum</i>).
Euphorbiaceæ.	Sun Spurge (<i>Euphorbia helioscopia</i>), Wood Spurge (<i>E. amygdaloides</i>), Perennial Mercury (<i>Mercurialis perennis</i>), Box (<i>Buxus sempervirens</i>).
Platanaceæ.	Plane (<i>Platanus orientalis</i>).
Ulmaceæ.	Elm (<i>Ulmus campestris</i>).
Urticaceæ.	Lesser Nettle (<i>Urtica urens</i>).
Cannabinaceæ.	Hemp (<i>Cannabis sativa</i>), Hop (<i>Humulus lupulus</i>).

- Moraceæ. Mulberry (*Morus niger*), India-rubber Tree (*Ficus elastica*).
- Juglandaceæ. Walnut (*Juglans regia*).
- Myricaceæ. Sweet Gale (*Myrica Gale*).
- Cupuliferæ. Hazel (*Corylus Avellana*), Oak (*Quercus Robur*), Spanish Chestnut (*Castanea vesca*), Beech (*Fagus sylvatica*), Hornbeam (*Carpinus Betulus*).
- Betulaceæ. Birch (*Betula alba*), Alder (*Alnus glutinosa*).
- Salicaceæ. Willow (*Salix caprea*), Poplar (*Populus* sp.).
- Coniferæ. Scotch Fir (*Pinus sylvestris*), Yew (*Taxus baccata*), Juniper (*Juniperus communis*), Arbor-vitæ (*Thuja* sp.).
- Palmaceæ. Dwarf Fan-palm (*Chamærops humilis*).
- Aroideæ. Cuckoo-pint (*Arum maculatum*).
- Lemnaceæ. Duckweed (*Lemna minor*, *L. trisulca*).
- Naiadeæ. Pondweed (*Potamogeton densus*).
- Alismaceæ. Water Plantain (*Alisma Plantago*), Flowering Rush (*Butomus umbellatus*).
- Hydrocharidaceæ. Frog-bit (*Hydrocharis Morsus-ranæ*).
- Orchidaceæ. Spotted Orchid (*Orchis maculata*), Tway-blade (*Listera ovata*).
- Iridaceæ. Iris (*Iris germanica*), Yellow Flag (*I. Pseudacorus*).
- Amaryllidaceæ. Daffodil (*Narcissus Pseudo-narcissus*), Snowdrop (*Galanthus nivalis*).
- Liliaceæ. Wild Tulip (*Tulipa sylvestris*), Blue-bell (*Scilla nutans*), Garlick (*Allium* sp.), Butcher's Broom (*Ruscus aculeatus*), Asparagus (*Asparagus officinalis*).
- Smilaceæ. Sarsaparilla (*Smilax officinalis*).
- Juncaceæ. Field Rush (*Luzula campestris*), Soft Rush (*Juncus effusus*).
- Cyperaceæ. Sedge (*Carex riparia*), (*Scirpus lacustris*, *Eleocharis palustris*), Cotton-Sedge (*Eryophorum polystachyum*).
- Gramineæ. Wheat (*Triticum vulgare*), Oats (*Avena sativa*), Barley (*Hordeum vulgare*), Rye (*Secale cereale*), Rice (*Oryza sativa*), Meadow Grass (*Poa annua*), Vernal Grass (*Anthoxanthum odoratum*), Fox-tail (*Alopecurus pratensis*), Timothy Grass (*Phleum pratense*).
- Filices. Polypody (*Polypodium vulgare*), Male Shield-fern (*Aspidium filix-mas*).
- Equisetaceæ. Common Horsetail (*Equisetum arvense*).
- Lycopodiaceæ. Stag's Horn or Club-moss (*Lycopodium clavatum*), *Selaginella*.

Musci.	Hair-moss (<i>Polytrichum commune</i>), (<i>Hypnum flagellare</i> , <i>Bryum</i>), Bog-moss (<i>Sphagnum</i>).
Lichenes.	(<i>Usnea</i> , <i>Cetraria</i> , <i>Parmelia</i>).
Fungi.	Truffle (<i>Tuber</i>), Mushroom (<i>Agaricus</i>), (<i>Cyathus</i>).
Algæ.	Sea-wrack (<i>Fucus serratus</i>), (<i>Corallina officinalis</i> , <i>Vaucheria</i> , <i>Ceramium</i>).

330. A series of 90 botanical wall-diagrams, mounted on linen and rollers, size, 67 cm. (26½ in.) high by 84 cm. (33 in.) broad, with 8vo explanatory text in German (353 pp.). Designed by Prof. L. Kny.

Published by Wiegandt, Hempel, and Parey, and subsequently by Paul Parey, Berlin. 1874-1886.
1888.

PLATE I. The structure of living vegetable cells, and the arrangement of their chief component parts; the two principal modes of protoplasmic movement within closed membranes (rotation and circulation) as well as the transitional stages between them.

PLATE II. The structure and development of starch granules.

PLATE III. The principal forms of crystals of oxalic acid.

PLATE IV. The chief phases in the conjugation of one of the larger species of *Spirogyra*.

PLATE V. Milk cells of *Euphorbia splendens* and vessels of *Lactuca sativa*.

PLATES VI., VII. Some of the principal forms of unicellular hairs.

PLATE VIII. Longitudinal section of a vascular bundle of a Dicotyledon.

PLATE IX. Fibro-vascular bundle from the interior of the stalk of *Saccharum officinale*. Transverse section.

PLATE X. The development of the embryo of *Brassica Napus*, L.

PLATE XI. The structure and development of the multi-lamellar epidermis of *Ficus elastica*, and of the cystoliths which occur in it.

PLATE XII. A corner of a section of the leaf of *Pinus Laricio*, showing the epidermis consisting of much thickened cells, the bast-like hypoderm, two stomata with funnel-shaped entrance, the strongly-folded membrane of the cells of the mesophyll, and a resin-canal enclosed by the last.

PLATE XIII. Stoma of *Thymus Serpyllum*, L., var. *Chamædrys*, from the surface and in section.

PLATE XIV. Transverse section through a bundle of the petiole of *Polypodium vulgare*, L.

PLATE XV. Part of a transverse section through a three-year-old twig of *Tilia parvifolia*, Ehrb.

PLATE XVI. Transverse section through a bundle from the stem of *Cucurbita Pepo*, L.

PLATE XVII. Longitudinal section of the growing apex of a root of *Secale cereale*, L.

PLATE XVIII. Transverse section through a developed embryonic root of *Secale cereale*, L.

PLATE XIX. Development of the ovule of *Ænothera biennis*, L.

PLATE XX. Median transverse section of the ovule of *Viola tricolor*, L., immediately after fertilisation.

PLATE XXI. Development of *Peronospora calotheca*, de Bary.

PLATES XXII., XXIII. Development of *Mucor Mucedo*, L.

PLATES XXIV., XXV. Development of *Puccinia graminis*, Pers.

PLATES XXVI.-XXVIII. Reproduction of the Florideæ:—*Nemalion multifidum* (Web. et Mohr); *Lejolisia mediterranea*, Bornet; *Dudresnaya coccinea* (Poir.).

PLATE XXIX. Development of the apex of the stem of *Hippuris vulgaris*, L.

PLATE XXX. Development of the apex of the stem of *Elodea canadensis* (Rich. et Mich.).

PLATE XXXI. Development of *Rivularia bullata* (Poir.).

PLATES XXXII., XXXIII. Development of *Eurotium*.

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PLATES XLI.-XLIV. Development of *Claviceps purpurea* (Fries.).

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PLATES LI.-LIII. Anatomy of the wood of *Pinus silvestris*, L.

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PLATE LVII. A similar section made after the formation of secondary wood has made some progress.

PLATE LVIII. Development of the periderm in young shoots of *Sorbus Aucuparia*, L.

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PLATES LXIII.-LXV. Development of *Sphaeroplea annulina*, Ag., var. *crassisepta*, Heinr.

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PLATES LXXIV.-LXXVI. Structure of the wood of *Quercus sessiliflora*, Sm.

PLATE LXXVII. Apical growth and branching of *Delesseria alata* (Huds.).

PLATE LXXVIII. Cell-division in the young staminal hairs of *Tradescantia virginica*, L.

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PLATES LXXXI.-LXXXIII. Development of the embryo-sac and its contents in *Monotropa Hypopitys*, L.

PLATES LXXXIV.-XC. Structure and development of *Marchantia polymorpha*, L.

331. A series of forty-two botanical wall-diagrams, on stout paper, 62 cm. ($24\frac{1}{2}$ ins.) high by 86 cm. (34 ins.) broad, in frames. Drawn by Dr. Arnold Dodel-Port and Carolina Dodel-Port. There is an 8vo translation of the German explanatory text into English by D. McAlpine, published by W. and A. K. Johnston, Edinburgh.

1888. Published by J. F. Schreiber, Esslingen a. N.

PLATE I. *Drosera rotundifolia*. 1, Expanded leaf viewed from above ($\times 45$); 2, Leaf with imprisoned insect after $2\frac{1}{2}$ hours ($\times 15$); 3, The same after 18 hours ($\times 15$).

PLATE II. *Schizomycetes*. 1, Bacteria in human blood; 2, Bacteria from putrefying infusion; 3, *Spirochæte Obermeieri*, from blood of patients suffering from relapsing fever; 4, *Spirillum undula*, from putrefying fluids; 5, Micrococci, from putrefying blood; 6, Micrococci from zooglæa, scum of putrefying fluids; 7, *Micrococcus prodigiosus*, from damp bread (all figures $\times 12,000$).

PLATE III. *Bacillus anthracis*. 1-5, Stages in the development; 6, Bacteria in the blood in cases of splenic fever; 7, Spore-producing filaments; 8, 9, Fragments of a chain of spores; 10, Portion of gelatinous scum with spores; 11, Free spores (all figures $\times 12,000$).

PLATE IV. *Volvox Globator*. 1, A sexual monœcious colony ($\times 1250$); 2, Fertilisation of an oogonium ($\times 2800$); 3, An unripe oospore ($\times 2800$); 4, Bundle of spermatozoids in the antheridium ($\times 4300$); 5, Isolated spermatozoids ($\times 4300$); 6, Spermatozoids killed by iodine to show the attachment of the cilia ($\times 4300$); 7, Part of the periphery of a colony ($\times 8000$).

PLATE V. *Volvox minor*. 1, Oospore in process of fertilisation; 2, Ripe oospore; 3, Rupture of the wall of the spore and swelling of its contents; 4, First division of the contents of the spore; 5, Four daughter-cells formed by the second division; 6, Germinating spores; 7, Young colony (all figures $\times 2660$).

PLATE VI. *Ulothrix zonata*. A, Filament of the alga; B-D, Zygospores in various stages of development; E, Ripe zygospore; F, Young filament from a macrozoogonidium; G, Groups of young filaments from microzoospores; H, Young filament produced without conjugation (all figures $\times 2400$).

PLATE VII. *Ædogonium diplandrum*. 1, Portion of a young filament before the sexual distinction is manifest ($\times 1000$); 2, Portion of a non-sexual filament with a zoospore escaping; 3a, Green zoospore; 3b, Two-celled plant formed from the green zoospore; 4, Portion of a female filament with two young oogonia; 5, Portion of a male filament with an androzoospore issuing from it; 6, Portion of a female filament with ripe oogonia; 7, Ripe oogonium just fertilised; 8, Oogonium with

oospore; 9, Germinating oospore; 10, Contents of the germinating oospore divided into four parts; 11, Four zoospores in the interior of the germinating oospore; 12, Young plant (figs. 2-12 \times 2500).

PLATE VIII. *Cosmarium botrytis*. 1-3, Multiplication by division; 4, Full-grown individual, with numerous oscillating granules in the clear vacuoles.

PLATE IX. *Chara fragilis*. 1, Part of a plant in fruit (\times 10); 2, Part of a young leaf with antheridia and archegonia (\times 82); 3, Part of a fertile leaf with almost ripe spore-bud (\times 400); 4, Ripe oospore (\times 200).

PLATE X. *Cystosira barbata*. 1, Plant at the time of fructification; 2, Part of a fructifying branch (\times 6); 3, Transverse section of the same (\times 120); 4, Group of antheridia ripe and unripe (\times 1900); 5, 6, Ripe oogonia (\times 1900); 7, Germinating oospores (\times 486).

PLATE XI. *Polysiphonia subulata*. 1, Part of a female plant (\times 84); 2, Ripe antheridium (\times 2000); 3, Portion of thallus with carpogonium undergoing fertilisation; 4, Ripe cystocarp with escaping spores (\times 600); 5, A, B Germinating spore, two stages (\times 900 and 2400); 6, Portion of a branch with tetragonidia (\times 480); 7, Stages in the germination of the tetragonidia (\times 600).

PLATE XII. *Mucor Mucedo*. 1, Full-grown mycelium (\times 150); 2, Stalk with unripe sporangium (\times 1800); 3, Ripe sporangium (\times 1000); 4, Stalk with remains of ruptured sporangium (\times 1800); 5, 6, Germinating spores (\times 6600).

PLATE XIII. *Peziza*. 1, *a, b*, Fructifications of *Peziza aurantia* (\times 35); 2, Section of one of the fructifications (\times 44); 3, Part of a longitudinal section (\times 550); 4, Part of the hymenial and sub-hymenial layers with asci (\times 2400).

PLATE XIV. *Endocarpon pusillum*. 1, Plant seen from above (\times 46); 2, Thallus five months old (\times 46); 3, Vertical section with ripe fruit (\times 800); 4, Single spore with hymenial gonidia attached (\times 2700); 5, Two spores germinating (\times 2700); 6, Germinating spore further advanced (\times 2700); 7, Rudimentary thallus (\times 2700); 8, Fresh hymenial gonidia (\times 4100); 9-11, Gonidia of various forms and ages (\times 4100).

PLATE XV. *Puccinia graminis*. 1, Germinating teleutospore (\times 2500); 2, Young leaves of barberry (*Berberis vulgaris*) with æcidia (\times 1); 3, Transverse section of barberry leaf with ripe æcidium (\times 270); 4, Germinating æcidiospore (\times 1350); 5, Wheat stalk (*Triticum vulgare*), with ears attacked by rust (\times 2); 6, Transverse section of wheat-leaf attacked by rust (\times 1000); 7, Layer of uredospores with teleutospore (\times 1300); 8, Layer of teleutospores in couch grass (*Triticum repens*) (\times 500).

PLATE XVI. *Marchantia polymorpha*. 1, Branching shoot with receptacles in various stages of development ($\times 15$); 2, Section of a young receptacle with underlying thallus ($\times 270$); 3, Ripe gemma; 4, Embryo plant from a ripe gemma ($\times 150$).

PLATE XVII. *Marchantia*. 1, Part of a thallus with archegonia ($\times 14$); 2, Somewhat older portion ($\times 8.5$); 3, Section through two fully-developed archegonia ($\times 1620$); 4, Portion of thallus with antheridia and gemmæ-cup ($\times 8.5$); 5, Section of male organs, showing antheridia ($\times 45$); 6, Part of the above section more enlarged ($\times 400$); 7, Mature female disc with sporogonia ($\times 9$); 8, Ripe sporogonium ($\times 63$); 9, Ripe spores with elaters ($\times 576$).

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PLATE XIX. *Aspidium Filix-mas*. 1, Transverse section of a fertile pinnule ($\times 350$); 2, Closed ripe sporangium ($\times 750$); 3, Burst sporangium ($\times 750$); 4, Two ripe spores ($\times 2500$); 5, Under surface of fertile pinnule ($\times 23$).

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PLATE XXI. *Equisetum Telmateia*. 1, Development of the aerial shoot ($\times 2$); 2, Transverse sections of the ripe spike ($\times 18$); 3, Fertile leaf from within ($\times 80$); 4, 5, Ripe spores ($\times 1500$); 6, Barren shoot ($\times 2$).

PLATE XXII. *Selaginella helvetica*. 1, Reproductive plant ($\times 23$); 2, Longitudinal section of a fertile spike ($\times 132$); 3, Young sporangium with spore mother-cells ($\times 1050$); 4, Tetrahedral division of a spore mother-cell ($\times 5200$); 5, Ripe microspore ($\times 352$); 6, Four ripe microspores ($\times 1750$); 7, Leaf with ripe microsporangium ($\times 132$).

PLATE XXIII. *Cycas circinalis* and *C. revoluta*. 1, Female plant of *C. circinalis* ($\times \frac{1}{5}$); 2, Young carpellary leaf ($\times 1$); 3, Older carpellary leaf ($\times 2$); 4, Fully-developed carpellary leaf of *C. revoluta* ($\times 3$).

PLATE XXIV. *Taxus baccata*. 1, Branch with flowers ($\times 5$); 2, Section of a flower ($\times 50$); 3, Branch with ripe seeds ($\times 1$); 4, The same ($\times 8$); 5, *a, b*, Ripe seed ($\times 10$); 6, Section of a ripe seed ($\times 120$); 7, *a, b*, Germinating seed in section ($\times 7$); 8, Young plant with cotyledons ($\times 2$).

PLATE XXV. *Pinus Laricio*. A. 1, Branch with leaves and terminal bud ($\times 1$); 2, Male flower ($\times 54$); 3, Longitudinal section of same ($\times 38$); 4, Detached stamen ($\times 100$); 5, Longitudinal section of a staminal leaf ($\times 88$); 6, Dry pollen grains ($\times 300$); 7, Optical section of a ripe pollen grain ($\times 2000$); 8, Germinating pollen grain ($\times 2000$).

PLATE XXVI. *Pinus Laricio*. B. 1, Three stages in the development of the female cone ($\times 1$); 2, Longitudinal section of a ripe female cone ($\times 40$); 3, View of a ripe female cone ($\times 21$); 4, Upper side of a fruit scale ($\times 37$); 5, Ovule ($\times 300$); 6, Ripe cone ($\times 4.5$); 7, Ripe seed ($\times 8$).

PLATE XXVII. *Pinus Laricio*. C. 1, Half-grown cone one year old ($\times 2$); 2, Longitudinal section of the same ($\times 2$); 3, Longitudinal section of the unfertilised ovule ($\times 140$); 4, Upper part of an unfertilised archegonium ($\times 370$); 5, The same at the moment of fertilisation ($\times 370$); 6, Ovum after fertilisation ($\times 285$); 7-9, Development of rudimentary embryos and suspensors ($\times 150$ and 240).

PLATE XXVIII. *Elodea canadensis*. 1, Flowering specimen ($\times 1$); 2, Part of stem with three whorls of leaves ($\times 8$); 3, Female flower ($\times 23$); 4, Upper surface of leaf ($\times 2200$).

PLATE XXIX. *Erythrotis Beddomei* (*Cyanotis Kewensis*). 1, Flowering branch ($\times 1$); 2, Inflorescence ($\times 13.5$); 3, Stamen ($\times 31$); 4, Staminal hair ($\times 300$); 5, Upper end of a young staminal hair ($\times 7320$); 6, A similar one further developed ($\times 7320$); 7, Single mature cell of the staminal hair ($\times 4400$).

PLATE XXX. *Cuscuta glomerata*. 1, *a, b*, Plant attached to *Aster bessarabicus* ($\times 1$); 2, Flowering shoot ($\times 5$); 3, Transverse section of *Solidago Mühlenbergii* with *Cuscuta* attached ($\times 63$); 4, Inflorescence of *Cuscuta* ($\times 17$); 5, Section of a flower in the first stage ($\times 17$); 6, Side view of a flower in the second stage ($\times 17$); 7, Young fruit ($\times 17$).

PLATE XXXI. *Lavatera trimestris*. 1*a*, Flowering branch ($\times 1$); 1*b*, Flower commencing to open ($\times 2.5$); 1*c*, Flower bud ($\times 9.5$); 2, Staminal whorl and apex of floral axis ($\times 360$); 3, Anther ($\times 1725$); 4, Anther in longitudinal section ($\times 1725$); 5, Anther somewhat more developed ($\times 1725$); 6, Pollen mother-cells ($\times 1725$); 7, Isolated pollen mother-cell ($\times 1725$); 8, Part of another lobe with two such cells ($\times 1725$).

PLATE XXXII. *Lavatera trimestris*. 1, 2, Isolated pollen mother-cells ($\times 1725$); 3, Young anther with filament and pollen grains ($\times 120$); 4, Anther somewhat younger ($\times 150$); 5, Stamens with pollen escaping ($\times 25$); 6, Transverse section of anther ($\times 1000$); 7, Sexual apparatus of the flower in the second or female stage ($\times 9$); 8, Fragment of the style ($\times 350$); 9, Pollen grains ($\times 120$); 10, Pollen grain ($\times 435$).

PLATE XXXIII. *Lilium Martagon*. A. 1, Plant in flower ($\times 1$); 2, Diagram of the flower ($\times 10$); 3, View of the flower,

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Salvia pratensis. 3, Flower seen from the side ($\times 6$); 4, Mechanical arrangement of the stamens ($\times 6$); 5, head of the bee (*Bombus hortorum*), which is the chief agent in fertilising this species.

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332. A series of botanical wall diagrams, in sheet; size, 33 in. by 27 in. Explanatory text in German. Designed by Drs. A. Tschirch and B. Frank. (An incomplete set.)

Published by Paul Parey, Berlin. 1890.

333. Diagrams (8) illustrating Prof. Archer's first steps to economic botany. Prepared for the Science and Art Department. 1854.

Published by Lovell Reeve.

334. Diagrammatic model, devised by Dr. F. Noll, for illustrating the growth in thickness of the stems of Dicotyledons.

E. 27.—1887. *Published by N. G. Elwert, Marburg.*

There are two bands, one representing cortex, the other wood and pith. Over their line of junction is placed a strip marked in cells to represent the cambium. A cord acting round a roller works the apparatus, and as the cambium deposits woody tissue on one side of it, and so is forced outwards, it also deposits cortical tissue on its outer surface, so that both wood and cortex increase in thickness *pari passu*.

335. A series of diagrams exhibiting in a graphic manner the absolute and relative quantities of the main constituents of food in fifty samples of wheat, barley, and oats, grown under various conditions. A specimen of the grain analysed is attached to each diagram. Prepared by Professor Tanner for the Science and Art Department.

1878.

Published by Chapman and Hall.

336. Elevations and plan of the laboratory for botanical research, presented to the Royal Gardens, Kew, by T. J. Phillips Jodrell, Esq.

Lent by Her Majesty's Office of Works. 1876.

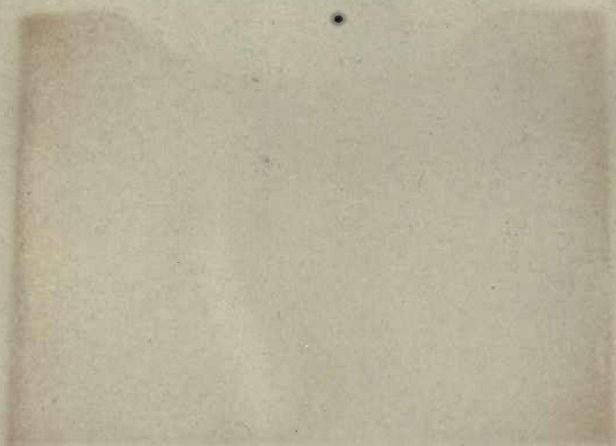
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